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MOONLIGHT TABLES.

As our readers are aware, this journal has for some years past made a practice of publishing early in December moonlight tables for street lighting work, to be used in the ensuing year. These tables have always been compiled for us by Mr. H. W. Frund, a well-known electric light manager. With the present issue we furnish as a Supplement, in the familiar form, Mr. Frund's tables for 1902, his own table and the standard moonlight system appearing side by side. We are glad to know that this effort is much appreciated, as evidenced not only by the inquiry for tables, but by their frequent appearance on the walls of electric lighting offices and central stations.

TELEPHONE MONEY ORDERS.

Last week and again this week, some of the leading American telephonists have discussed the suggestion that the telephone might be applied like the telegraph, to money order business. It appears from some of the replies that attempts in this direction have already been made, but, of course, they are sporadic and involve no general system. Mr. Kempster B. Miller puts his finger on the great underlying difficulty when he points out that in the case of the telegraph the wires are in the hands of the company, and that with the telephone the wires are in the hands of the public. Unless our memory is at fault, even the telegraph has been tapped or misused by swindlers, to secure the payment of money orders, for which there were no funds in transit, and the telephone would certainly lend itself to collusion and trickery of that kind. Still there is an oportunity for managerial and inventive ability, and in due time a feasible scheme may be worked out.

ELECTRICITY IN GERMANY.

That trade and industry are in bad shape in Germany everybody knows, but we do not see why the *New York Herald*, in its European edition, should be so insistent in loading the whole blame on electrical development. The articles transferred to the local columns of our contemporary are so wild and unfair they seem inspired by a malicious effort to help in depressing German electrical securities. In an article appearing this week, a financier is presented as discussing the situation, and as saying, *inter alia:* "The electric boom came like St. Michael with the flaming sword. The people were as though fascinated under the electric influence. Such a sudden springing up of industries in so short a time with so much capital, with such powerful companies, had been unknown before." * * * "The public was foolish. There has never been in any industry such a desire to finance enterprises in order to obtain special profits as in this electrical boom. But they expected too much." From what we know of the situation this is gross exaggeration. It is true that electrical industries in Germany have been over-stimulated like others, and that some of the methods of financing were injudicious; but to load the whole blame on electricity is little short of an outrage.

We have noted recent events in Germany, and one recollection we have is that the biggest and worst failure had something to do with a grain treatment enterprise quite outside the electrical field. We have discussed the general question with German friends, and have published sober articles from German authorities, and in no sense do we gather confirmation of the *Herald's* attack on electricity. To the contrary, we venture to believe, from the evidence before us, that when German commerce revives, as it will, the electric lighting plant,

trolley road, and electro-chemical industries, will be among the survivors and among the first to prove their permanent earning and dividend-paying capacity.

The Electrified Manhattan.

In our first two issues of this year we gave an elaborate account of the new power house equipment of the Manhattan Elevated, and of the track as adapted to electricity. It now appears that the company hopes to set the plant in practical operation this week, and to furnish current to the Second Avenue line. Mr. Gould speaks hopefully of the early operation of that section of the system by electricity, in which respect we shall be heartily glad to see his expectations justified. Under the regime of steam the Manhattan has made a splendid record of which it can be justifiably proud, but it having been recognized that steam has its limitations for city work, the electrical era cannot now begin any too soon, for the welfare of the road and the benefit of the public. It is a long time since Daft and Sprague and Field did their interesting experimentation on the Elevated, and at one time it looked as though no demonstration would suffice to effect a change; but the electrical period is now beginning and it ought to be good for the road in every way. We note that Wall Street is inclined to take such a view of the situation, for the value of the stock has been steadily higher and rising, making new records. It will, however, be many months before the whole system can be converted and get the full force of the change, and while some of the best talent in the country is engaged on the road, there will doubtless be occasions in the future as now when the public will have to exercise patience if things go a bit amiss.

Efficiency Tests of Direct-Current Generators and Motors.

The article of Mr. W. L. Smith in this issue calls attention to the advantages of the stray-power method of testing the efficiency of direct-current machines. This method is often the only one which can be resorted to in the case of large machines tested singly. When two similar machines are at hand for testing simultaneously they may be connected together as generator and motor, according to the Hopkinson method, in such a manner that when both are operated at full load only the energy losses have to be supplied from the external source, or driving engine. The efficiency found in this way is more reliable than the efficiency computed from losses, partly because two machines are employed, and the resulting efficiency is the mean derived from a pair of machines under simultaneous test, and partly because the machines are each actually subjected to full-load conditions.

When, however, only a single large machine has to be tested, it is often difficult to procure either a suitable load for the full output of the machine, on the one hand, or a sufficient driving power for the input of the machine on the other hand. Under these conditions the determination of the losses is the only method left available, and, if carefully executed, the results are sufficiently accurate for practical purposes. It is customary to assume that this method of testing will be applied when specifications are made for the efficiency of motors and generators. The great convenience of the method lies in the fact that even in the case of a very large machine, say, of 3000 kw capacity, the total losses will only be about 2 per cent of this power, or 60 kw, and this is the maximum amount of power which has to be directly computed, while the losses actually measured will be usually only about half of this, or 30 kw for the case considered. The various requirements for making the test are given in outline in the Standardization Rules of the American Institute of Electrical Engineers.

Facts and Fancies of the "Inner Circle" Arbitration.

For some weeks past we have been watching with no little interest the evidence in the extraordinary arbitration case involving the electrical equipment of the Inner Circle of the London underground road, and as we go to press a cablegram reports that the arbitration committee has decided against the use of the Ganz system and in favor of the direct current. The story of the dispute is rather long and not particularly edifying, but it finally culminated in a series of weary hearings before a referee, at which some of the most distinguished engineers in the world gave testimony. The real parties to the litigation are the Westinghouse and the British Thomson-Houston companies and others, who tendered direct-current apparatus on the one hand, and Ganz & Co., who underbid them with a three-phase tender, on the other hand. The hearing represents the final efforts of both parties to get the business. On one side were marshalled Messrs. E. W. Rice, Jr., Philip Dawson, J. R. Chapman and James Swinburne; on the other, Messrs. Blathy, Kapp, Cardew, S. P. Thompson and Professor Ewing. The former group held tenaciously to the opinion that the system proposed in Ganz & Co.'s tender would prove costly, unreliable and unsatisfactory, the latter that it would fully and certainly meet all the requirements. We had hopes that such an inquiry with such witnesses would throw a great flood of light upon the question of direct vs. polyphase currents for traction, but taking the evidence by and large we must frankly confess that as an exhibition of *ex parte* irrelevancy it stands unique.

It is admitted by all parties that the direct-current equipment proposed by the American "undertakers," as they cheerfully put it on the other side, will do the work and do it thoroughly well, so far as results are concerned. It is maintained by the Ganz Company, and denied by the direct-current exponents, that the three-phase system will do the work equally well, and at a less first and ultimate cost. The former state unequivocally that by going to low frequency and using induction motors in concatenation they have fully solved the troublesome problem of regulation which has been held to disqualify the induction motor for traction service. Ganz & Co., moreover, state that with motors so arranged they have developed the needful power of acceleration and are ready to do business, to which their opponents make answer by denying the equivalence of the conditions, and politely doubting the truth of the allegations. In this stage of the dispute appeared some of the most trivial pettifogging that could well be imagined. For example, learned counsel for plaintiff called attention of plaintiff's witness to the form of trolley car shown in defendant's tender, and elicited the important information that the best practice is tending toward something else, as was doubtless true. But does any one suppose that either party would be shy and bashful about taking a cue from the other when it came to a detail of installation? Assuredly not, unless perhaps the device were patented. And, finally, after the Ganz tender had thus been picked at in detail it was damned in its totality as untried and experimental, quite unworthy an investment on the part of conservative business men. We do not wish to criticize our friends severely, but where would the multiple-unit system on which they rely, be if it had been accorded a similar hearing? On its face it is a nightmare of complication, but, thanks to the skill of our American engineers, it has been worked out into conspicuous and solid success.

The questions at issue are far bigger and broader than the conduct of the dispute. From the large engineering standpoint the first thing to be decided is whether Ganz & Co. have or have not evolved a method of controlling polyphase motors which puts them for traction purposes on substantial equality with direct-current

motors. This is a matter which cannot be ascertained by an *ex parte* investigation of any kind. It is a simple question of fact, to be properly decided by tests on the part of a small and impartial committee of engineers, whose decision ought to be conclusive. If their report were in the negative, we think that no rational board of directors would further consider the Ganz tender. If it were favorable, the next step should refer to the same body the question of relative expense and efficiency on definite assumed conditions of traffic agreed to by both disputants. This step should show definitely whether there is any considerable balance in favor of one or the other. At even money or near it, the direct-current proposition, being for apparatus and methods already approximately standardized, would surely take precedence on the ground of a reasonable conservatism. Finally would come up the broadest question of all, that of general policy in view of extensions and connecting lines—to our minds, a very important matter. This is far more than an engineering question, for it involves not only the adaptability of both methods to conditions of development, but the present and future traffic and financial relations of all the lines involved, which only the insiders know or can guess.

There is an amusing side to the whole matter which must jar upon the nerves of our British cousins. It must be a trifle distressing to see so acrimonious a discussion carried on with the sole object of determining whether a particularly fat British contract shall be taken in by Americans or Austrians. For ourselves, we stand by our countrymen, and suggest that heed be given to such persuasive logic as that of Mr. Parshall, who, unless he has lost his old-time prowess, will come near to having the last useful word. But it is well to understand fully that so far as engineering goes the present investigation has up to date let in precious little engineering light.

PRESSURE OF RADIATION.

Maxwell showed, in 1873, that in accordance with his theory of the electromagnetic nature of light, all radiant energy exerts a pressure in the direction of its path, numerically equal to its volume energy. The truth of Maxwell's theory concerning the electromagnetic wave nature of light has since been amply demonstrated, but until quite recently no one has been able to verify the existence of this pressure exerted by light. The reason is that the pressure is so small. For example, sunlight at the earth's surface has a voluminal energy of about 40 micro-ergs per cubic centimeter, and it is supposed that above the atmosphere, that is to say, before the absorption of the atmosphere has come into play, this would represent about 70 micro-ergs per cubic centimeter. Consequently, the push of the sun's radiant heat and light only amounts to 70 micro-dynes per square centimeter, or about 0.7 milligram weight per square meter of normally exposed surface. In other words, a sheet of perfectly black material 1 meter square and supported perpendicular to the sun's noonday rays would only receive a pressure of about 0.4 of a milligram at the earth's surface underneath the atmospheric ocean, while immediately above the surface of the atmospheric ocean it might be about 0.75 of a milligram. If the surface instead of being perfectly black, or wholly absorbent, were absolutely polished, so as to be wholly reflective, these theoretically deduced pressures would be just doubled. With an intermediate surface condition, the theoretical pressures would be between these limits, and would be in the neighborhood of a milligram per square meter.

There would be no difficulty in measuring repulsive forces of this order of magnitude on a torsion balance, but as soon as a vane is supported on a torsion balance and exposed to radiation, either in air or in a highly exhausted chamber, the repulsion which is observed is very much greater than that now considered, and is due to the Crookes effect of molecular bombardment under unbalanced thermal conditions. The Crookes radiometer is nothing more than an apparatus for rendering evident the apparent repulsive forces of radiant energy on a scale much greater than that of the Maxwellian pressure component. It is, therefore, necessary to remove the large Crookes effect from the apparatus before the feeble Maxwellian pressure component can be made apparent.

Two papers on the experimental investigation of this subject have recently appeared, both written about the same date (August, 1901), and both published about the same date (November, 1901), one from Moscow by Lebedew, in the *Annalen der Physik*, and the other by Nichols and Hull from Dartmouth College in the *Physical Review*. Both papers come to the conclusion that after removing, as far as possible, the large Crookes effect, there is an observable residual pressure of the order of magnitude conforming with the Maxwellian law. It is unnecessary to enter into the details of the methods by which the experimenters, working apparently independently of each other, have endeavored to free their observations from the Crookes effect. Broadly speaking, Lebedew, whose results appear to have the greater precision, employed very high vacua. He used an arc lamp throwing about 1-13 of a watt of radiant activity upon his suspended vanes, producing a pressure of about 31 microdynes. These residual pressures were independent of the color of the incident beam, and were within about 10 per cent of the calculated Maxwellian pressure. Nichols and Hull obtained a measured pressure of 105 microdynes against a calculated pressure of 134 microdynes.

The experimental difficulties in the way of accurate observations are quite considerable. The incident activity of the beam has to be measured carefully, and also the mean coefficient of reflection of the surface for the whole spectrum of incident rays, because the coefficient of reflection is not necessarily the same for all waves. These requirements alone call for considerable experimental skill, and when the elimination of the Crookes effect is further taken into account, the difficulties become very great. From a scientific standpoint, however, it is quite important to have the Maxwellian theoretical pressure carefully checked by experiment, and it is to be hoped that still closer and more reliable experimental results may be obtained in the near future.

The total luminous pressure of the sun upon the earth is about 100,000 tons, on the basis of Maxwell's repulsion law; but this is only about the 1-40,000,000,000,000th part of the gravitational attraction, so that the astronomical influence of the radiant pressure becomes insignificant, in the case of the earth. If, however, we consider matter as separated out into a very thin layer of small spheres, each having a density equal to the earth's mean density, then the smaller the spheres, the greater will be the ratio of the radiant repulsion of the sun's light to the gravitational attraction of the sun's mass, because the repulsion varies as the square of the radius of the particle, while the attraction varies as the cube. At any considerable distance from the sun, the attraction and repulsion become theoretically equal upon a spherical particle of matter, about one-quarter of a micron in radius or half a micron in diameter, that is to say, having a diameter about equal to the wave length of violet light. Segregated particles smaller than this would be pushed from the sun, while particles larger than this would be pulled towards it, if it is safe to assume that particles can absorb energy and cast shadows from radiant waves whose lengths are large in comparison with their own dimensions.

Nobel Prizes Awarded.

As recently stated in these columns, the Nobel endowment for certain prizes became available this year, and a cablegram received last Tuesday announces that the prizes for the past year have been bestowed as follows: Physics, Professor Roentgen; chemistry, Professor Van't Hoff; medicine, Dr. Behring, of Marburg; literature, M. Sully-Prudhomme, of Paris. The prize for greatest service tending toward promoting the fraternity of nations, and the abolishment or diminution of standing armies and the formation and increase of peace congress was divided, one-half going to M. Dunant, founder of the Red Cross Society, and the other half to M. Passy, a French deputy and peace advocate. The amount of each of the five prizes, which are to be bestowed annually, is 208,000 francs. The details of the plan for disposing of the Nobel endowment fund have already been given in our pages.

Electrical Engineers of the Day.—XXIV.

G. Herbert Condict.

George Herbert Condict was born in 1862 in Newark, N. J., and received his education in the schools of New York and Philadelphia and the University of Pennsylvania. In 1882 he entered the employ of the Central Gas Light Company, of San Francisco, and the following year built the gas works in East Portland, Oregon, and repaired and extended the gas works in Eureka, Calif. For six months he had an experience in gold mining among the mountains of Santa Catalina, in Arizona. Returning to San Francisco in 1884, he became connected with the Pacific Coast Electrical Construction Company, which had been newly organized to manufacture and install electric lighting and power apparatus, as well as storage batteries under the patents and management of Dr. Nathaniel S. Keith, a former editor of this journal.

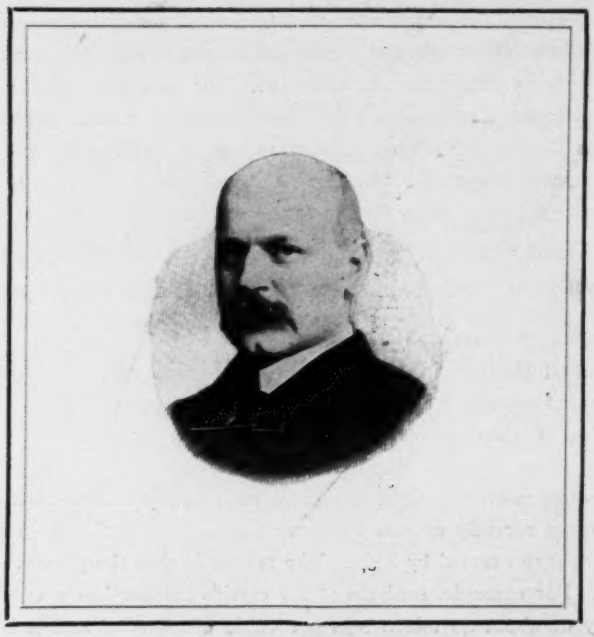
In the summer of 1885 Mr. Condict became the Pacific Coast agent of the Van Depoele Electric Company. In order to become thoroughly conversant with the company's apparatus he moved temporarily to Chicago, and became Mr. Van Depoele's assistant in his electric railway and lighting experiments. He installed several lighting plants, and took an important part in the construction of the electric railway in South Bend, Ind., which was the first road with overhead trolley to institute a commercial service in the streets of any city. In 1885 he installed Van Depoele's exhibition trolley line at the New Orleans Exposition, which at the time attracted wide attention. Returning to California in 1886 he installed several lighting plants in mines and sawmills, at the Sacramento State Fair and in other places. In 1887 he took charge of the storage battery street car experiments for William Wharton, Jr., in Philadelphia, which resulted in the organization of the Electric Car Company of America, of which he became the general manager.

It was while engaged in developing the various practical details of the electrical apparatus for the equipment and control of the electric street car of that day, that Mr. Condict invented, patented and first put into service the combined series-parallel and dead resistance controllers with which his name must always be associated. Although it had been considered possible to regulate the speed of electric motors by arranging for different groupings of their coils in series or parallel with each other, yet no successful controller of that type had been made or used. The practice had been to depend solely upon an exterior rheostat connected in series with the motors for the purpose of limiting the rush of current with the armature stationary, and for regulating their speed thereafter, the windings of the motors remaining undisturbed.

Mr. Condict conceived the idea of rendering possible and practical the series-parallel type of controller by combinng with it dead resistances in such relations as to enable the required circuit changes to be made without undue shock and without damage to the apparatus or danger to the operator, all by the movement of the same handle. Economical speed regulation was accomplished by cutting out the dead resistances and then connecting the windings of the fields, the armatures and the motors themselves, in series, parallel or multiple-series or series-multiple combination—that is, in the relation best adapted to the working conditions. Although the controller to accomplish these various combinations among the motors and their coils was initially designed for service in connection with storage batteries, its principles were simple and fundamental. The patents covering the device have conferred enormous advantages upon their owners, and Condict's series-parallel controller when considered as an invention involving far reaching effects commercially and economically, must be classed among the most important factors in electrical development.

In 1887 the Electric Car Company of America undertook to demonstrate the commercial practicability of the storage battery car for city service, and a complete power station and car equipment were subsequently installed by Mr. Condict for the Lehigh Avenue Railway Company, Philadelphia. During the next two years he developed and exploited the storage battery and other inventions of Dr. Isidor Kitsee, which resulted in the incorporation of the North American Electric Storage Battery Company, of Philadelphia, with Mr. Condict as its engineer. In 1893 he became the Pacific Coast agent for the Electric Storage Battery Company, with headquarters in San Francisco, but returned to Philadedphia in 1894 to conduct the engineering work of that company. In 1894, at Merrill, Wisconsin, he installed the first storage battery plant to be used in the United States as an auxiliary to provide for fluctuations of railway load.

During 1896-7 Mr. Condict, as chief engineer and general manager, laid 22 miles of track, built the power house and installed the entire equipment for operating 50 cars for the Englewood & Chicago Street Railway, and afterwards operated the road. The cars were operated by storage batteries, and the important feature of the installation was the successful handling on a large scale, by mechanical means, and with a minimum of attendance heavy battery car equipments. From a mechanical and electrical point of view this installation was notable and successful, but uncommercial from lack of receipts due to its poor location. Mr. Condict's methods and apparatus established by the operation of the Englewood plant have since been adopted by the Metropolitan Street Railway Company, of New York, in the installation of storage battery apparatus for its Thirty-fourth Street cross-town line, for which he acted as consulting engineer.



In 1897 Mr. Condict entered the automobile field as engineer-in-chief of the Electric Vehicle Company, of New York and Hartford, Conn. He installed in New York in 1897-8 the first electric vehicle station, the batteries of which were entirely handled by machinery. Under his direction, as consulting engineer, practically all the automobiles operated in public service by the New York Electric Vehicle Transportation Company have been designed, built and maintained in service. The large new operating station of the same company, which is equipped with apparatus for handling mechanically the batteries for 500 vehicles, was also installed by Mr. Condict, and he is still connected with that company as consulting engineer.

Mr. Condict is a member of the American Institute of Electrical Engineers, the New York Electrical Society, Franklin Institute and the Engineers' Club.

Electricity at the Charleston Exposition.

BY CHARLES T. MALCOLMSON,
Chief Engineer.

THE illumination of the grounds and buildings at the South Carolina, Interstate and West Indian Exposition is neither as large nor pretentious as the lighting at the Pan-American. It follows rather the more delicate display of the Chateau d'Eau at the "Exposition Universelle de 1900," of Paris. It is interesting and unique, and shows, perhaps, a step onward in what may be called the classic in Exposition lighting.

The grounds are divided into two parts. The Art Section includes the Court of Palaces, combining the Cotton Palace, the Palace of Commerce, the Palace of Agriculture, with their contiguous colonnades into one continuous, horseshoe shaped building; the Auditorium, Administration, Mines and Forestry, Dairy and Live Stock buildings and the Midway. The Natural Section includes the Machinery, Transportation, Art, Woman's, Negro, Fisheries and all the State buildings, the Race Track and Parade Ground.

The general illumination of the grounds and the interior of the buildings is furnished by arc lamps, while incandescents accentuate the lines of the exterior of the buildings. In the center of the Court of Palaces will be found the "Sunken Garden," which is so graded that the lake which surrounds it will reflect the buildings and the myriads of lights to the observer who follows the main walk about this court. The garden is filled with every variety of semi-tropical vegetation, making a beautiful horticultural display. At the head of the sunken garden is placed a pergola with an electric fountain, the water from which, after flowing from the pipes of a Macmonnies Pan and running over basin after basin finally reaches the lake. In the center of the garden is another group representing "The Triumph of Electricity Over Water Power," also with electrical effects. Each shore of the lake is outlined at the water's edge with many colored incandescent lamps, while the whole garden gleams with points of light among the pathways and hedges. At the foot of the Garden is placed a conning tower from which will be flashed great bands of colored light, changing and blending themselves on the facades in the interior of the court.

In Lake Juanita in the Natural Section has been placed the Electrical Island. Here we have the latest development in electric fountains, while on the bridge on the axial line of the Machinery Building will be placed an electrical booth, built up entirely of art glass and gorgeously illuminated by water on which plays an electrical color scheme. This booth is in the form of a half globe representing the southern hemisphere, with Charleston located in jewels. In the electrical booth as well as in the electrical island, day and night effects will be produced. The shore of Lake Juanita will also be outlined in incandescents.

Turning to the practical side of the uses of electricity, the endeavor in this exposition has been to install as nearly as possible a power transmission plant combining a treatment of all the problems that the engineer meets in such an installation. Electricity is used almost exclusively for power and lighting purposes, and every available form or application will be found in practical form on the grounds. The power plant is about two miles from the center of distribution. In it are installed one 500-kw, one 300-kw, one 150-kw and one 100-kw General Electric three-phase, 2300-volt, 60-cycle compensated alternators, belted to one 700-hp, one 500-hp and one 300-hp Harrisburg 4-valve Corliss engines. The boiler plant consists of three 500-hp Babcock & Wilcox water-tube boilers. The current is transmitted to the grounds over two trunk lines composed of six No. 0000 cables. These lines are brought to the substation situated in one tower of the Auditorium Building, and distributed at 2300 volts in ten circuits from a high-potential switchboard of the latest improved type. The switchboard is of blue

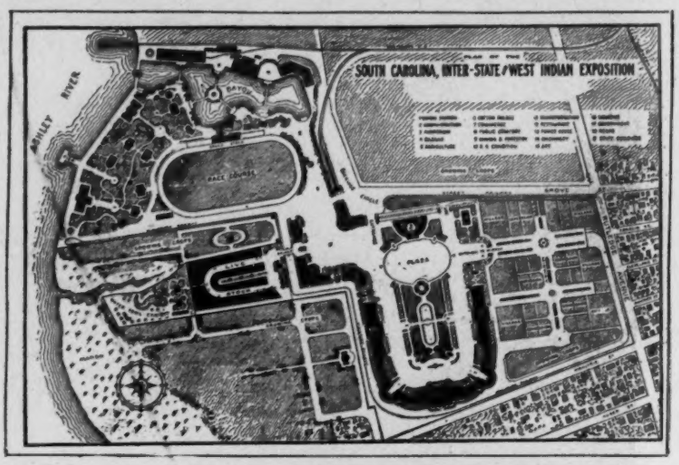


FIG. 2.—MAP OF CHARLESTON EXPOSITION GROUNDS.

Vermont marble in five distributing panels 65 by 24 inches, and five sub-panels 25 by 24 inches, and one receiving panel 65 by 30 inches, with one sub-panel 25 by 30 inches. Each distributing panel contains two double-throw, three-pole, 50-ampere oil switches; 12 expulsion fuse blocks, six series transformers. The receiving panel contains two 200-ampere, three-pole, single-throw "G. I." automatic circuit breakers, six series current transformers, 36 ammeter switches, two indicating A. C. wattmeters and a swinging voltmeter scale 1-150. There are the necessary bus-bar connections for two complete circuits, so that any or all of the 10 high-potential distributing mains may be carried on either of the two trunk lines. By this arrangement all the service lighting load and the interior lights in the buildings can be carried on one set of bus-bars, while the exterior lighting load may be built up, from the machine, giving the impressive effect produced at several previous expositions. Each pole of each current is fused in front of the switch controlling it. The oil switches and circuit breakers were manufactured by the General Incandescent Arc Light Company, of New York, and the switchboard was furnished by the Wagner Electric Manufacturing Company, of St. Louis. To the trunk line is tapped in the arc light circuit board, furnished by the General Electric Company. This board is in four panels of blue Vermont marble, and each panel contains

FIG. 1.—VIEW OF COURT OF PALACES.

distributing switches for two circuits and an ammeter with current transformer.

All the wiring for incandescent lighting and alternating current for power purposes is on the three-phase system with four-wire secondaries. Each circuit may contain one or more groups, but each group contains three transformers with their primaries in delta and their secondaries in star connections. By balancing each group within itself a fairly good balance of the system is maintained. In this arrangement 200 volts is available for power purposes, and 115

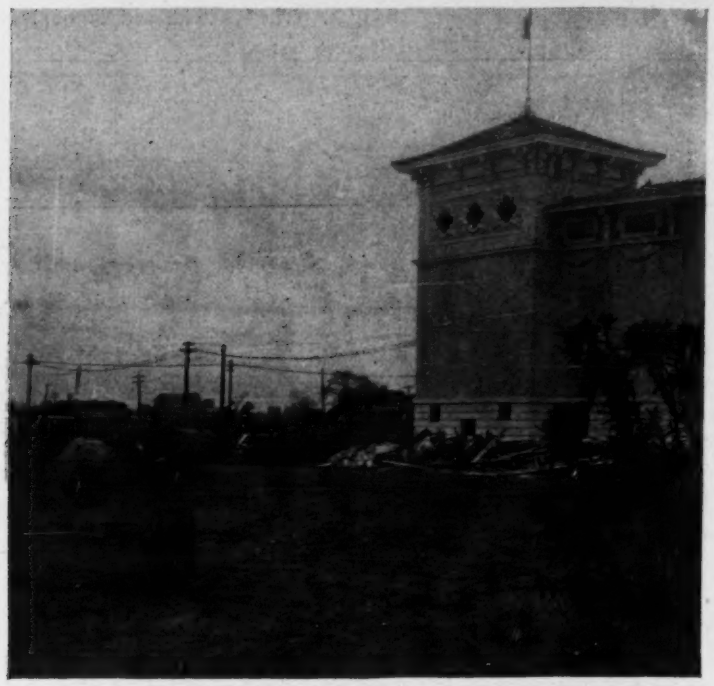


FIG. 3.—AUDITORIUM BUILDING AND TRANSMISSION CIRCUITS.

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Electricity in a Newark, N. J., Department Store.

THE new department store of Hahne & Co., Newark, N. J., which was opened during the past summer, is one of the largest and most complete establishments of its kind in the world. No expense was spared to make it most modern in construction and equipment, and very naturally electricity enters largely into the plans, although not to so great an extent as might expected in an up-to-date plant where "the best to be had" was the first consideration in its fitting out. Thus we find here a curiously composite operating equipment —hydraulic, pneumatic, steam and electric. The plant is also singular in the adoption of hydraulic elevators instead of electric, which latter have come to be regarded as a necessary part of the equipment of every large modern building.

The lighting of a building of this character and size is necessarily a matter of great moment, and secondary in importance only to the building itself, the other features—elevators, cash carriers, steam generation, etc.—being of relatively minor importance. In the lighting of this store, which is said by experts to be the best lighted store in the country, electricity was, of course, adopted, and science and practice were combined to produce the most effective and harmonious results in the illumination of the immense floor space, the area of which aggregates nearly 12 acres. In developing the plans mere lighting was not the only object in view. Due consideration had to be given to the character of the business carried on in the different departments. In some, incandescent light proves most advantageous in displaying the goods, while in others arc light is more suitable, therefore, in the distribution of the light much care was exercised to obtain the best results. Close proximity of arc light and incandescent light gives an illumination of a reddish cast, which obviously had to be carefully avoided. This was accomplished by separating the lamps of the two classes sufficiently to give the light the proper quality and the greatest quantity of it, resulting in a harmonious distribution which is very noticeable, neither class being preponderant.

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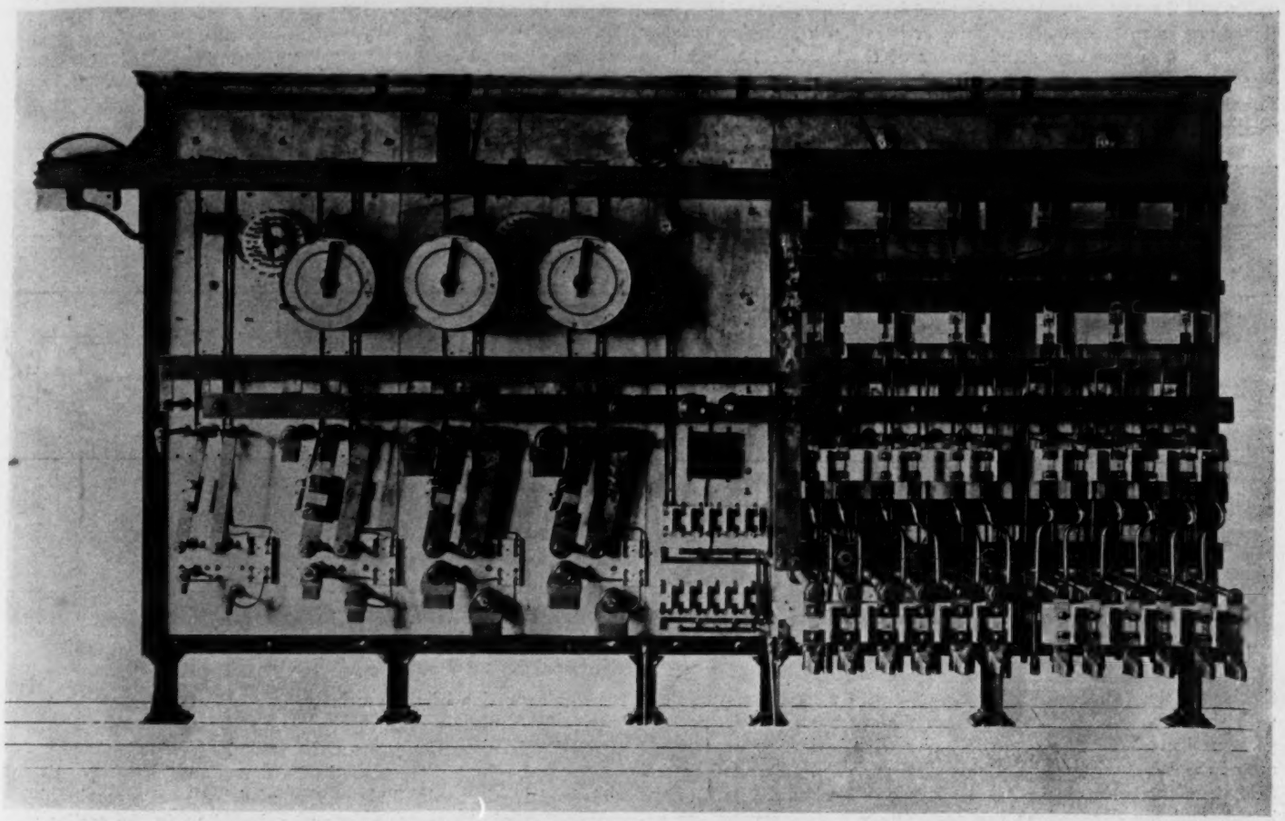

FIG. 1.—VIEW OF BACK OF SWITCHBOARD IN NEWARK DEPARTMENT STORE.

The electric generating plant includes four generators—two 200-kw Crocker-Wheeler multipolar machines, each direct connected to a 325-hp horizontal Harrisburg engine, running at 200 r. p. m.; one 100-kw generator of the same make, and similarly connected to a 150-hp Harrisburg engine; and one 50-kw Siemens & Halske machine direct connected to an 80-hp Ames engine. One of the 200-kw machines is sufficient to carry the ordinary day load, and the Siemens & Halske generator is used for night lighting after the building is closed to the public. The latter machine is of the external armature type, with the commutator on the outside. The Crocker-Wheeler apparatus is the standard make. This latter type of generator was de-

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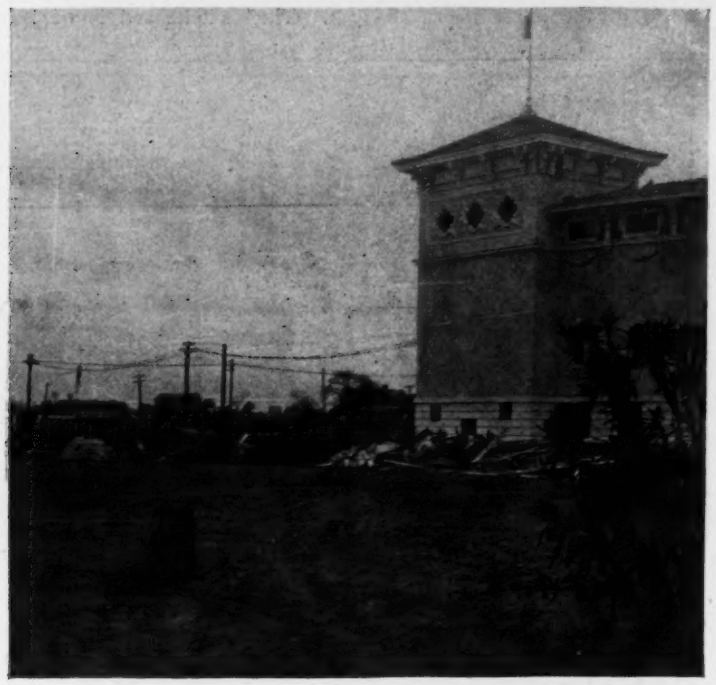

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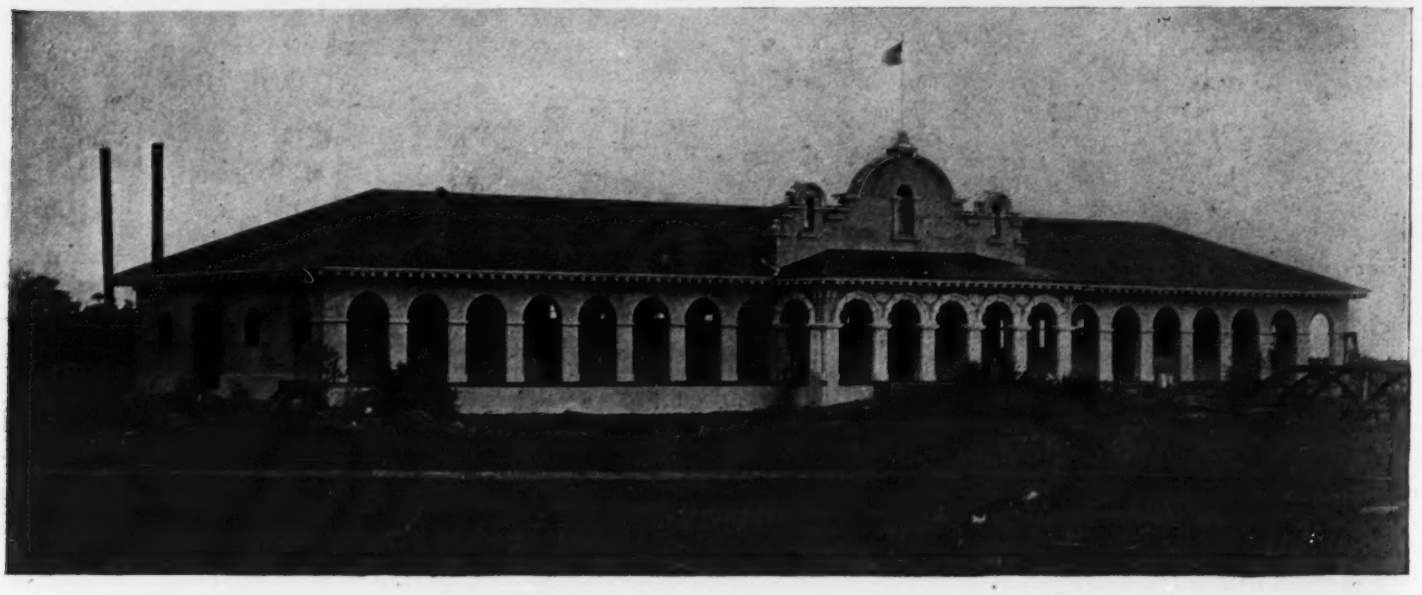

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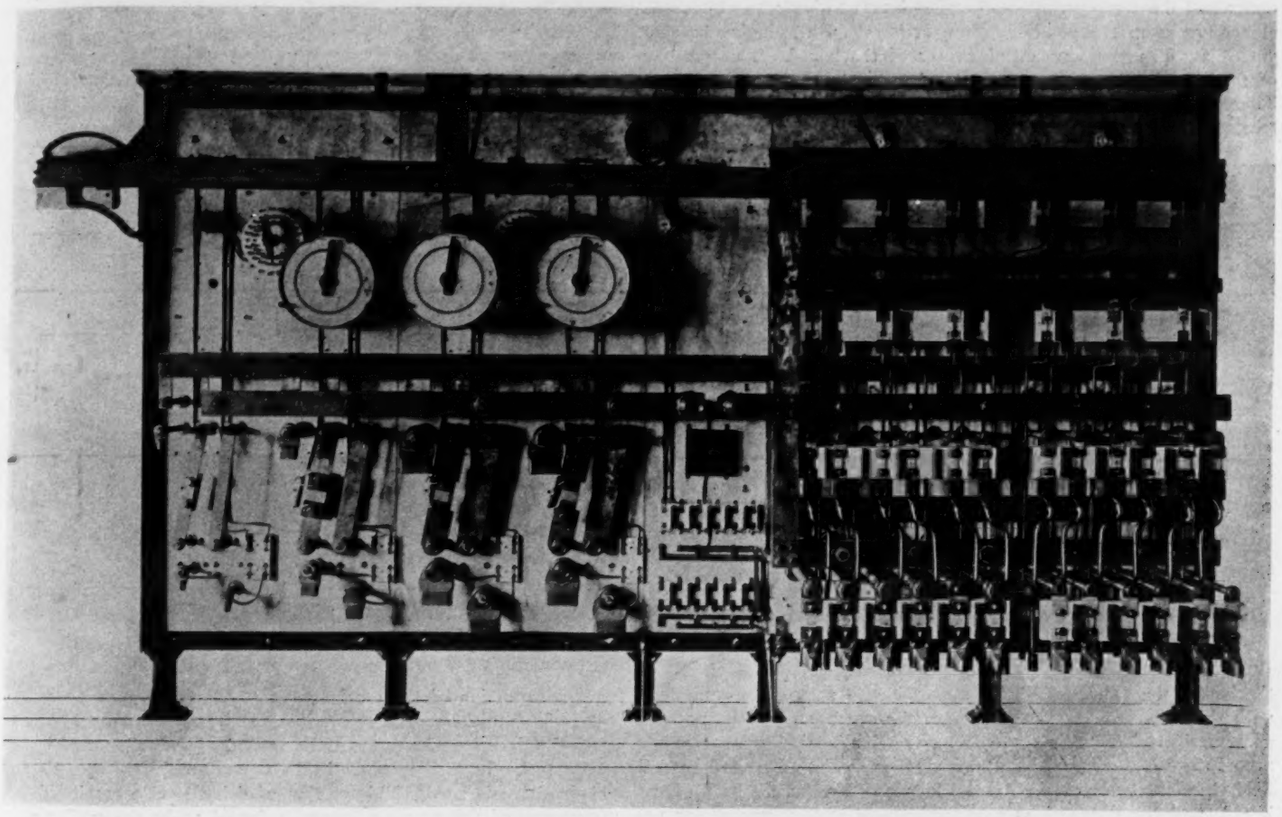

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scribed, as to some of its principal features, and illustrated on page 751, of ELECTRICAL WORLD AND ENGINEER, Nov. 2. The future enlargement of the plant is provided for in the allowance of the necessary space for an additional generating unit.

The main switchboard, which was built by the Walker Electric Co., of Philadelphia, is of white Italian marble, and is supported by 12-inch cast bronze feet. It is 8 ft. from the floor to the ornamental marble coping, the length of the board being 14 ft. 3 inches, divided into five panels. There is ample space at the back to permit of work on the connections, etc. The board controls the four generators and 30 feeder circuits. The total output panel of 5000 amperes separates the generator panels from the feeder panels. All the feeder cables were brought to the bottom of the feeder panels and fused at that point. The board contains four Cutter new type laminated circuit breakers, and the usual equipment of generator and feeder switches. The switches are constructed of drawn copper throughout, and are built up on the unit blade principle; that is, there is an independent single-blade switch for each side of the circuit. Each generator switch consists of three such unit blade switches, the third one being for the equalizer bus-bar.

Among other features of the board are a swinging dynamo voltmeter and the arrangement of the pilot lamps to indicate which machines are in operation. The voltmeter is set on a swinging bracket placed at the upper right-hand corner of the board. This permits of readings being readily taken from any part of the switchboard. There is also a voltmeter on the output panel. The pilot lamps are located directly under the ammeters and placed in holes cut through

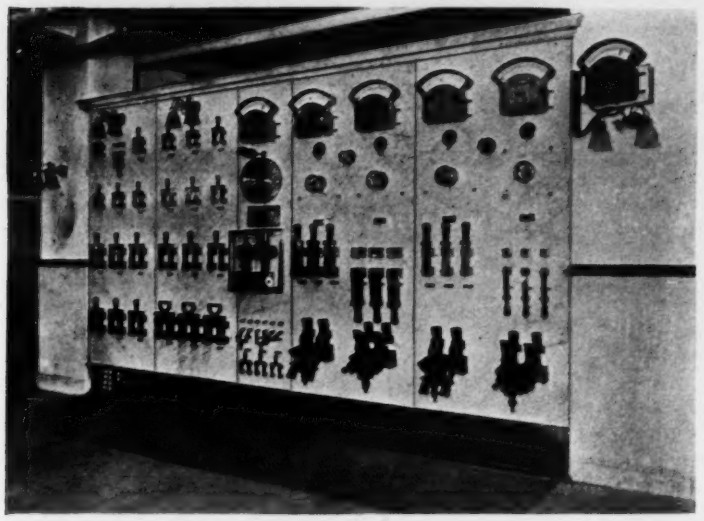


FIG. 2.—FRONT VIEW OF SWITCHBOARD.

the board, the front ends being covered with ruby glass, and flush with the surface of the board; hence the operation of any machine gives a visual indication by a red light. The indicating instruments are of the Weston standard station dial type, Ward Leonard enamel field rheostats being used. All the fusing is done at the back of the board, and the connections are particularly well arranged for accessibility for re-fusing. The bus-bars are built up of 4-inch copper bars. A noticeable feature in the construction of the board is the absence of cables at the back. The connections between the switch terminals and bus-bars are made by means of studs and heavy copper rods, which arrangement gives great compactness, being at the same time symmetrical in appearance. The dynamo leads are covered with manila tarred rope.

On the front of the board, at the center, is a G. E. 5000-ampere recording wattmeter, which registers the total output of the plant. For so large an establishment the few switches on the board is strikingly noticeable. The main board, however, does not control the general distribution. There are five sub-boards under the control of the main board and from these the mains run to panel boards on the different floors, there being 72 marbleized slate panel boards in all, 8 to 12 on each floor. Most of the sub-boards are fed by four 450,000 cm. cables, run from the main board in multiple. The wiring throughout the building is run in 30 miles of loricated conduits manufactured by the Safety Conduit Company, of Rankins Station, Pa., Grimshaw wire being used.

The electric plant was designed for a total capacity of 13,000 arc and incandescent lights. Four hundred Manhattan enclosed arcs are used in the lighting of large spaces, and 10,000 incandescents supplied by Messrs. Goodchild & Welsh, of Newark, are distributed throughout the building, over 1200 being used in the illuminating of the grand court alone. The distribution of this light in the grand court is effected by means of lamps bunched on fixtures attached to the columns on each floor surrounding the court.

An important feature in the lighting scheme is the showcase lighting, there being 3100 case lights in use throughout the store. The showcases take the place of the old style counter, and are constructed entirely of glass, standing on the floor. The case lights are arranged along the upper interior edges of the cases and by the aid of shields, throw the light downward upon the goods, the lamps being so effectually screened that the eye of the observer does not perceive the direct light at all. These light were installed by the Barker Wire Company, of New York. They are finished in nickel, the wires being run in nickeled tubing. In the illumination of the show windows 450 ft. of Frink's special window reflector are employed. Besides this there are 175 Frink sectional glass cluster reflectors used throughout the interior of the store.

Electric power very naturally fills an important role in the business of the establishment. It is utilized in operating the machinery in eight manufacturing departments, Crocker-Wheeler motors, ranging from 2 to 14 hp, being used for this purpose. They are placed on the floor and belted to floor shafting. The departments requiring power include the shade, cloak and suit manufacturing, millinery, carpet sewing, picture frame, furniture and upholstering departments, carpenter shop, etc. An interesting application of electric power is

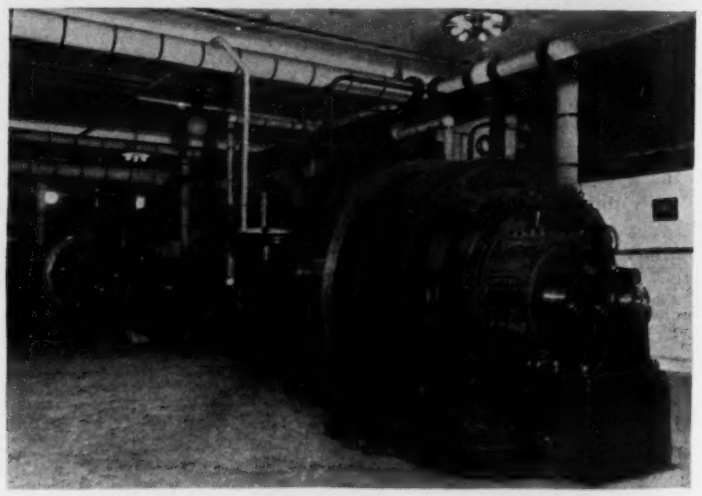


FIG. 3.—ONE OF THE GENERATING UNITS.

in the operation of the escalator, or stair lift, which runs from the main floor to the second story. This stairway was built by the Link Belt Engineering Company, of Nicetown, Philadelphia, and is driven by a 10-hp Lundell motor. In its operation this company's silent-chain drive is used. This system of drive is also employed in the operation of the merry-go-round referred to in the earlier part of this article. This ingenious type of stairway was fully described and illustrated in ELECTRICAL WORLD AND ENGINEER, of Sept. 22, 1900, since when it has been considerably improved.

The steam-generating plant consists of four 300-hp Caldwell water-tube boilers, arranged in two batteries of two each. They are hand fired, the coal being dumped in front of the boilers directly from the trucks. One of the principal constructional features of these boilers is the design of the header. The header castings, into which the tubes are expanded, are composed of one piece, are quadrangular in shape and are provided with openings or hand holes in front, thus providing access to the tubes. The Caldwell boilers are made by James Beggs & Co., New York.

The steam power equipment is commensurate with the importance and magnitude of the business carried on in this establishment. The refrigerating machine, with a daily capacity of 7 tons of ice, was made by the Remington Machine Company, Wilmington, Del. Three compound Deane pumps are used for the elevator work, one for the surge tank and two for the pressure tanks, a Westinghouse air compressor supplying the necessary pressure for the two last-named tanks.

The telephone equipment for the firm's business consists of 65 in-

dividual telephones connected to a private Bell exchange, through which the public exchanges of the New York & New Jersey Telephone Company is reached from any one of the 65 instruments. There are also a public pay telephone station and a telegraph office on the premises.

The Thompson-Starrett Company, of New York, was the general contractor for the building and its equipment complete; the electrical plant was designed and installed under the supervision of Mr. H. D. Babbitt, the company's electrical engineer. Mr. Benjamin F. Pangborn, chief engineer of Hahne & Co., has charge of the plant. The architect of the building was Mr. G. Starrett and Messrs. Clinton & Russell, consulting architects.

The Stray Power Method of Testing Direct-Current Motors and Generators.

By Wm. Lincoln Smith.

ONE of the simplest methods of testing direct-current generators and motors, while at the same time easy of application, rapid and exceptionally precise in its results, is that known as the "stray power" method. I am led to writing these notes upon this method not because they contain anything novel, nor because they will prove of especial interest to thoroughly trained engineers, but because of the interest I trust they may have for numbers of persons having to do with medium-sized machines in shops, and similar situations, who would appreciate the possibility of making at intervals a test for efficiency quickly and easily, without the necessity of moving the machine or of setting up any large amount of auxiliary apparatus.

In this method the instruments needed are a speed counter, a voltmeter (preferably with a high and low scale) and an ammeter capable of reading the current required to drive the machine as a motor running idle. If the machine is a generator we must provide also a resistance suitable for starting it, and it is well to have at hand a couple of short-circuit plugs so that the ammeter may be readily shifted from armature to field circuit without shutting down. In what follows:

W_0 = output, W_i = input, L = total loss, f = commercial efficiency.
V_t = volts at terminals, I_l = current in line,
V_b = volts at brushes, I_a = current in armature,
R_a = resistance of armature, I_m = current in field,
R_m = resistance of field, P = stray power.
N = speed,

The commercial efficiency of a dynamo is equal to the net output divided by the input, or

$$f = W_0 \div W_i = (W_i - L) \div W_i = W_0 \div (W_0 + L)$$

In the case of a generator where the output can be determined electrically we should use the last form; in the case of a motor for the same reason we should use the second term. If we are working from the "name plate data" the output will, of course, be taken from the plate and no full load readings made.

In either case, if we can determine the losses directly under the desired conditions, we can find the efficiency under rated load (or at any other desired point) without the necessity of measuring any quantity mechanically, so avoiding all errors due to more or less rough mechanical methods.

The quantity L is made up of

1° $I^2 R_a$ in the armature circuit.
2° $I^2 R_m$ in the field circuit.
3° Hysteresis losses.
4° Eddy current losses.
5° Windage, bearing and brush friction, etc.

Although these losses all appear ultimately as heat, the first two are classed together as heating loss, and the remainder are lumped together and called "stray power."

The heating losses are readily determined for any load, provided we know the warm resistances. The stray power will vary from time to time, and is a function of 1° field strength and 2° speed; and other things remaining the same, it will vary in some way with these two quantities, so that we may say with an exceedingly close approximation to the truth, that if at different times tests be made under the same conditions of field strength and speed, the stray power found will be the same.

Now, how may this quantity be determined? Suppose the machine to be run as a motor under no load. Evidently the power supplied is simply that required to balance the losses, and hence if we measure V_t and I_l; the product of these two will give the sum of the losses at no load in watts; and if from this sum we subtract the two heating losses the remainder will be the stray power.

The following example will make the whole process clear. Suppose we have a shunt motor rated at volts 220, speed 1200 and horsepower 5.

Let the machine be run long enough to be thoroughly warmed up and then running idle, measure and find

$$V_t = 220.0 \qquad I_l = 2.3 \qquad I_m = 0.3 \qquad \therefore I_a = 2.0$$

Then shut down the machine and find the armature resistance; or

$$V_b = 5.0 \text{ and } I_a = 10.0, \text{ and } R_a = 0.5 \text{ ohm.}$$

Now, $V_t I_l = 220.0 \times 2.3 = 506$ watts = input or loss;
$V_t I_m = 220.0 \times 0.3 = 66$ watts = heat in field.
$I_a R_a = 2 \times 2 \times 0.5 = 2$ watts = heat in armature.
$P = 506 - (66 + 2) = 438$ watts = stray power.

At full load (by name plate)

$$W_0 = 5 \text{ hp} = 5 \times 746 = 3730 \text{ watts.}$$
$$W_i = 3730 + P + V_t I_m + I^2_a R_a$$

V_t = 220.0, I_m may be assumed as before = 0.3, and I_a is given by $I_a = (3730 + 438 + 0.5\, I^2_a) \div 220.0$
or, $I_a = 19.84$ amperes.

Then at full load

$P = 438$, $I^2_a R_a = 197$, and $V_t I_m = 66$, or
$L = 701$; $W_0 = 3730$; $W_i = 3730 + 701 = 4431$.
$f = 3730 \div 4431 = 84.2$ per cent.

Very often the result as found above is close enough, but it is seen at once that we have taken no account of any possible change in the stray power in passing from no load to full load, and as such change is certain to occur we must for close work either correct for it or else make the run under full load conditions of speed and field. We must then have some quantity to serve as an indicator of field strength so that, the speed being fixed, we can tell when the field strength has been reproduced. The best quantity for this purpose is the voltage developed by the armature, or $V_b + I_a R_a$ in the case of a generator, and $V_b - I_a R_a$ in the case of a motor, i. e., the armature voltage.

We may now proceed in two ways: First, estimate the full-load current and calculate at what voltage the machine must be run as a motor idle in order that its armature voltage may be that which it would have when running fully loaded under normal conditions. Then by simultaneous adjustment of field resistance, lead and terminal voltage, produce for the idle run the exact full load conditions of speed and armature voltage. We may then feel confident that the stray power found is what we ought to use. Of course, we may apply the same process for any desired fractional part of full load and thus determine the complete curve for the machine.

We shall find, however, that these adjustments are laborious and somewhat difficult to make, and fortunately they are not required in the majority of cases.

Second, it has been found by a careful study of the variation of stray power and speed and of stray power and armature voltage that within not too wide limits it may be assumed that the stray power varies linearly with speed and linearly with the armature voltage, and may, therefore, be corrected in proportion to the changes in those quantities.

Returning to the example, suppose that we had also made a reading of the speed at no load and found it to be 1220 r. p. m.

Since the correction is not large, it will be close enough if we assume the full-load armature current to be 20 amperes.

Our armature voltages then are

Full load, $220 - (20.0 \times 0.5) = 210.0$
No load, $220 - (2.0 \times 0.5) = 219.0$ (at $N = 1220$)
No load, $219 \times (1200 \div 1220) = 215.0$ (at $N = 1200$)

The stray power then will be

$$438 \times \frac{210}{215} \times \frac{1200}{1220} = 421$$

For full-load current, I_a (found as before) will be 19.76, and

$$L = 421 + 195 + 66 = 682,$$

$$W_i = 4412, \qquad W_o = 3730, \text{ and}$$

$$f = 3730/4412 = 84.6 \text{ per cent},$$

as compared with 84.2 per cent obtained by neglecting to make the correction. The stray power is, of course, made up of two parts, one of which varies as the square of the armature voltage and the other directly as the speed. These two parts can be separated, but it is sufficiently close to work as above. Again, the several components of the stray power vary among themselves from time to time, but we can assume that they do not all vary the same way at once.

It is safest to get as near to the full-load conditions of speed and armature voltage as convenient without undue waste of time, as in that case the results are, of course, rather better. In regard to the brushes, one should take care not to disturb them in any way after the desired conditions are reached, as a very slight change in position or quality of contact with the commutator will make a serious change in the other conditions of the test.

The chief advantages of this method are that it is simple and accurate, it requires little apparatus, the machine does not have to be loaded, all measurements are electrical, the assumptions are close to the truth for closed-coil machines, and the time required is brief.

On the other hand, it does not bring out faults which might show up under full load, the stray power may be slightly smaller than it should be, and hence the efficiency found slightly higher than the true value. Taking it all in all, however, the method is probably better than almost any other for direct-current machines of moderate sizes except, of course, open-coil machines.

The Economic Design and Management of Telephone Exchanges—II.

By Arthur V. Abbott, C. E.

As a preliminary to entering into the details of the subject, the following definitions of terms that will constantly occur are given:

DEFINITIONS.

General or Fundamental Terms.

a. *Central Office, Central Station,* or *Central.*—The building or office space, switchboard, and all auxiliary apparatus, excluding cable entrance and cable terminals, required for placing subscribers in talking relations with each other, without the use of trunk lines extending outside the building in which the switchboard is located.

b. *Exchange.*—A collection of central offices connected by trunk lines over which any subscriber tributary to any of these offices may talk without paying toll charges, often used synonymously with central office. An exchange must have one central office, and it may have several.

c. *Territorial Exchange.*—A collection of exchanges and connecting toll-lines under the management of one corporation.

d. *Wire Plant* or *Line Plant.*—All of the installation required to provide electrical connection between the outside walls of sub-stations (see *Sub-Station*), and the main distributing boards (see *Main Distributing Board*) of the Central offices to which the sub-stations are tributary, and in addition includes the plant connecting the *Main Distributing Boards* of the various central offices in a given exchange.

e. *Sub-Stations.*—The term "Sub-Station" designates either the place at which the subscriber's outfit is located, or generically all the apparatus required for the equipment of a subscriber.

f. *Branch Exchange.*—There are many cases of isolated groups of subscribers who desire to talk frequently among themselves, and to have occasional connection with other exchange subscribers. To pass all the messages that such a group originates through the central office would require an unnecessary outlay both in apparatus and service. Hence it is customary to place such subscribers in a small switchboard by themselves, connecting them to the central office by one or more trunk lines. Such an installation is called a *Branch Exchange.*

g. *Bridge.*—A shunt, electrical circuits, or pieces of apparatus carrying electrical currents in parallel are said to be bridged or in bridge.

h. *Message,* often called *call* or *connection,* sometimes a *switch.*—The act of signaling the central office, also the conversation which takes place between two subscribers. Messages are divided into (1) originating messages, or those which are made by subscribers in signaling the office to which they are attached, and (2) trunk messages, or such messages as proceed from the office in which they originate over trunk lines through some other office to the called subscriber.

i. *Noise, Induction, Cross-Talk.*—Any line on which any sound can be distinguished other than the conversation of parties at the ends thereof, is said to be *noisy* or afflicted with *induction.* When conversation passing over a neighboring line can be distinguished there is said to be *cross-talk.*

j. *Private Exchange.*—A branch exchange without trunk lines to a central office.

k. *Repeating Coil.*—Two coils of wire so wound on the same core that electric impulses in one will excite corresponding impulses in the other; a transformer. Repeating coils may be step-up, even, or step-down, depending on the mutual relations of the primary and secondary windings.

l. *Retardation* or *Retardation Coil.*—An inductive resistance.

m. *Telephonic Center.*—That point within any group of subscribers from which the sum of the distances, measured along streets, to all sub-stations, is minimum.

n. *Trouble.*—When any piece of apparatus is out of order, or a circuit does not operate in a normal manner, it is said to be in *trouble.* Employes, whose business it is to remedy such defects, are called *Trouble Men,* and the difficulty when removed is said to be *Cleared.*

SUBSIDIARY TERMS.

Central Office Equipment.—The entire outfit, excluding building, cable entrance, and cable terminals needed for a central office, usually divided into four parts: (1) The switchboard, (2) the distributing boards, (3) the power plant, (4) the operator's furniture.

The Switchboard.—The switchboard is that portion of a central office equipment provided to enable operators to answer subscribers' signals, connect them together in talking relations, and disconnect lines when conversation is complete.

Types of Board.—There are two distinctive fundamental types of switchboard in use. One, the *Multiple Board,* in which on each subscriber's line, the jacks (see Jack) are repeated or *Multiplied* a sufficient number of times to place a jack on each line within the reach of every operator that can sit at the board; the other, the *Transfer Board,* in which there is only one jack to each line, and every operator who wishes to connect to a subscriber whose jack is not in front of her must *transfer* the message to some other operator before whom the desired subscriber's jack does appear. These two types shade into each other in all degrees.

There are also three other distinctive switchboard features leading to a subordinate classification under the preceding general divisions. These three features involve the methods whereby electrical energy is supplied for signaling and talking. (a) *Magneto Boards* are those in which the calling and clearing-out signals (see Signals) are actuated by current obtained from a small magneto generator driven manually by the subscriber, and electricity for talking is supplied by a local battery at each sub-stations. (b) *Automatic Signal Boards* are those in which the calling and clearing out signals are given automatically by the removal and replacement of the receiver (see Receiver) on the hook (see Hook), electricity therefor being supplied from a battery at the central office. Under this division also fall a small number of boards, tending to become obsolete wherein the call signal is made by pushing a button, and the clearing out is automatic on the replacement of the receiver, battery being supplied from the central office to actuate the signals only. (c) *Common Battery Boards* are those in which *all* electricity both for automatic signaling and talking is supplied to all subscribers from one *Common Battery* located at the central office. Common Battery Boards are frequently called Relay Boards, or Central Energy Systems, and automatic signal boards are also, though erroneously, so termed. It is obvious that these types of board may be built on either the multiple or transfer system.

Sub-Divisions of Switchboards; A. & B. Boards.—The *Switchboard* in every exchange having more than one central office is divided into two parts, one devoted to receiving calls from the subscribers connected directly to the office under consideration, and in making connection between such subscribers and others either located in the same or other offices. This part of the switchboard is called the *A Board,* the *Subscribers' Board,* the *Answering Board,* or the *Originating Board.* The other portion of the switchboard is

devoted to *receiving* calls made by subscribers connected to *other offices only*, and in making connections only to subscribers in the office under consideration. This portion of the board is called the *B Board*, the *Trunking Board* or the *Connecting Board*. Where there is only one central office, no B boards exist. The construction of these two parts of the switchboard is, in some features, radically different.

Position.—Every switchboard may be considered to be made up of a number of exactly similar yet entirely distinct units, each unit being that amount of apparatus necessary to the vocations of *one single operator*. Such a collecation of apparatus is called a *Position*. As the functions of an operator at an "A" Board are different from those at a "B" Board, the "A" positions will be differently equipped from the "B" positions, so it is usual to speak of any switchboard as consisting of so many "A" positions and so many "B" positions, and as each position of each kind is similar to all the others of the same kind the total cost of the board is easily obtained by multiplying the cost of each kind of a position by the number of each.

"A" Position.—Each "A" position may be divided into three parts. (1) The Subscriber's Line Equipment. This is usually understood to embrace a protector (see Protection), a pair of terminals (see Terminal) in the main and intermediate boards (see Distributing Board), an answering jack and signal (see Signal), together with all connecting cable and other auxiliary apparatus. In magneto boards the signal is a drop (see Drop), but in automatic signal, and common battery boards, it is a small incandescent lamp, operated by a relay (see Relay), and the subscriber's line equipment includes the lamp and socket, relay and cut-off or controlling relay for extinguishing the lamp when the operator answers, together with a unit portion of the relay racks and connecting cables. (2) *The Multiple.*—The *Multiple* or *Multiple Jacks* comprise the entire outfit of jacks needed to enable each operator to transact all the business that comes to her. The Multiple Jacks are divided into two parts, the *Subscribers' Multiple*, or the jacks that are attached to subscribers' lines, and the *Out-Trunk Multiple*, or the jacks that are provided to enable each "A" operator to have access to all of the trunk lines (see Trunk Line) that extend to other offices.

(3) *The Operator's Equipment.*—Each operator must be provided with apparatus wherewith two lines may be connected together, must be able to receive instructions from the calling subscriber, and be able to ring the party called for. To connect lines together it is usual to provide a pair of plugs (see Plug), fitting the spring jacks that are connected by a flexible cord (see Cord); by placing one of the pair called the answering plug into the jack of the subscriber calling, and the other called the connecting plug into the jack of the one called for, the two lines are connected together. Each pair of cords is supplied with a switch or key (see Key), so constructed that when the handle is moved in one direction the receiver and transmitter supplied to the operator are connected to the line and when in the other the operator sends ringing current over the line of the called subscriber. In magneto boards, a drop placed across the cords notifies the operator when conversation is complete, while in Automatic Signal and Common Battery boards, a pair of lamps is attached to each cord informs the operator when each party replaces the receiver. These are called *Clearing-Out or Supervisory Signals.*

Thus the pair of cords and plugs with the associated ringing and listening keys and signals complete a cord equipment of which from 10 to 17 are placed in front of each operator on an appropriate shelf. Each operator is supplied with special lines extending to the chief operator, and to the trunk operators in other offices in exchanges of several central offices. These lines are called *Call Circuits* or *Order Wires*, and the switches connecting them to the operators' talking circuit "Order or Call Wire Keys." In the modern boards, a *Pilot Signal* placed in parallel with all the line and supervisory signals, calls the operator's attention night or day to the fact that business is to be transacted.

"B" Positions.—"B" Positions differ from "A" Positions in two important respects. There are no outgoing trunk jacks, as "B" operators receive calls from other offices only. Each trunk from other offices, equipped with a cord, plug and clearing-out signal, terminates on a shelf before the "B" operator. Hence, the "B" operator has only single cords and plugs of which there are usually 25 or 30 per operator; a key to ring the called subscriber that is frequently arranged to be automatically tripped by the removal of the called subscriber's receiver from the hook, and no listening key.

Electric Automobile Stages in New York City.

REFERENCE has been made from time to time in these pages to the acquisition of the Fifth Avenue stage line by the New York Electric Vehicle Transportation Company, and we are now glad to be able to announce that the electric automobile omnibusses or stages that have been promised are actually in operation. It is the intention that in due course of time the electric shall supersede entirely the horse vehicles, which are recognized as being an anachronism as well as out of keeping with the handsome thoroughfare which they traverse. President Henry Sanderson and Mr. G. H. Condict, the engineer of the company, have been giving a large amount of time and attention lately to this work, and have had the satisfaction of putting in operation this new service at an opportune juncture. Last week when the weather had rendered the streets a mass of ice and it was pitiable to witness the efforts of horses to pull even the lightest vehicle, electrics of every kind were able to circulate freely and swiftly, and to negotiate any of the glassiest hills with the minimum of trouble.

The Fifth Avenue omnibus headquarters are in East Eighty-eighth Street, near Fifth Avenue, and the regular line of route is from the corner of those two thoroughfares down Fifth Avenue straight away to the Triumphal Arch on Washington Square and Bleecker Street. At the present time the new owners have 36 horse busses in service operated normally with 236 animals, and with two hill horses on the

FIG. 1.—ELECTRIC AUTOMOBILE, FIFTH AVENUE STAGE LINE.

incline at Thirty-fourth Street. The rate of the fare has been 5 cents for one trip in one direction, without commutation or transfers. The time occupied in a round trip has been 1 hour and 40 minutes, but this is being considerably cut by the electric stages, which already, with stops at every four blocks, have shown a speed of 38 minutes 30 seconds in one direction and 34 minutes 30 seconds in the other, or less than an hour and a quarter. At the present time there is a discrimination of fare in favor of the old horse stages, as 10 cents is charged for a ride in the electric stages. The electrics, however, furnish a superior and luxurious means of travel. The insides are handsomely upholstered and cushioned. A tall man can move around freely without jamming his hat, as in the old stages; the lighting is electric, and everything is clean and sweet. No conductor is carried, fares being placed, as usual, in a receptacle at the driver's end of the vehicle, and the driver is, therefore, in sole command of the vehicle. The driver is trimly costumed in a uniform with brass buttons, and wears the familiar automobile cap. On the sides of the vehicle are neatly painted labels announcing the fare.

The omnibuses have two motors of 4 to 6 hp capacity, each driving on the rear axle, with exposed spur gearing at each side. The vehicles are steered by wheel, and have the standard form of Electric Vehicle Company's controller. The batteries in use for the smaller vehicles are of the Exide type, and there are 48 cells, giving four hours' capacity at a discharge of 70.4 amperes, the average discharge running 60 to 65 amperes on the third notch, or equal to a speed of slightly over 12 miles an hour; the four approximate speeds for the four notches being 3, 6, 12 and 15 miles an hour. The approximate

weight of this battery with the tray is 3800 lbs. The only call upon the batteries outside of propulsion is for the two side lights and the two flat bulb marine lights in the interior of the vehicle. The weight of the smaller busses is given as 10,350 lbs., while the larger busses with battery complete will weigh nearly 15,000 lbs. These busses of

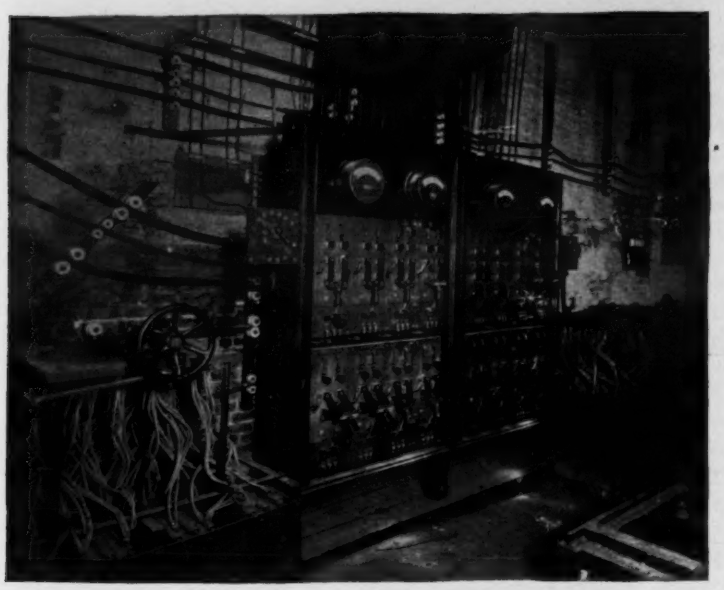


FIG. 2.—SWITCHBOARD OF CHARGING PLANT, FIFTH AVENUE.

the various types owe their design largely to the skill and thought of Mr. A. L. Riker on behalf of the Electric Vehicle Company.

For this new service the New York Electric Vehicle Transportation Company has not encroached upon the facilities of its huge livery plant at Eighth Avenue and Forty-ninth Street, described elaborately in these pages last January, but has, as already stated, occupied the old quarters of the Fifth Avenue stage line at East Eighty-eighth Street. The building there is, in fact, of a very solid and substantial nature, but, of course, has needed some remodeling to render it available for the added work. The company has not put in a charging plant of its own, but takes current from the local mains of

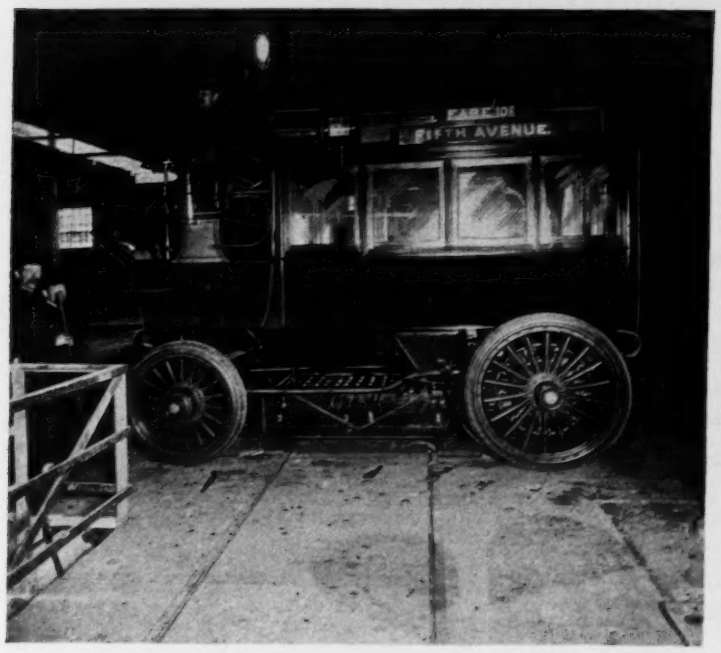


FIG. 3.—HYDRAULIC LIFT FOR BATTERIES.

the New York Edison Company. Up to the present time the apparatus for handling the batteries and charging them has been of a simple but adequate nature, the chief feature of interest consisting in the method for transferring the cells to and from the vehicles. It will be noticed from looking at the views here given of the omnibusses that the battery is not of the end-loading type familiar in electric hansoms and cabs, but is of the under-slung pattern; that is, it is supported underneath the floor of the vehicle instead of being placed under the seats and pushed in from the front or rear.

The apparatus for transferring these battery trays is very simple. It consists of a hydraulic ram, capable of lifting a net load of 5000 lbs., set in a pit under the floor of the charging station, and a few four-wheel trucks. The vehicle which is to receive a battery is run over an opening in the station floor above the ram on which the battery has previously been placed, and the tray is then hoisted into locking position on the vehicle. One of our cuts shows the operation.

When not in position on a bus, the battery is on a truck, which runs in a parallel direction to the length of the vehicle, on short lengths of rails placed on a second or transfer truck. This transfer truck runs on rails at right angles to the length of the vehicle. Thus a battery may be moved in either of two directions until accurately centered under the vehicle. Sixteen charging stalls are provided, as shown, on the station floor level, divided into two rows of eight stalls each, between which is situated the track on which the transfer truck operates. A truck, carrying a battery which has been charged, is pushed from the charging stall on to the transfer truck, which in turn is pushed on to the platform of hydraulic ram and lowered into the loading pit. This pit is large enough to contain four transfer trucks—two on each side of ram—besides a truck on the ram platform.

As it becomes necessary to place a freshly charged battery on a bus, the vehicle is run over the pit and an empty battery truck is raised into position under the battery, lifting the same far enough to allow of the withdrawal of the latches which support the tray in position under the bus, the truck is lowered into the pit and pushed off to one side, and a second truck, containing a charged battery, is brought on to the ram platform and hoisted into operating position on the vehicle. The ram is then lowered into the pit, carrying the trucks with it, and the bus is ready for a run of a maximum distance of 50 miles.

Water is furnished to the loading ram at a pressure of 150 lbs. to the inch, by a triplex hydraulic pump, a storage tank being connected to the piping in order that an even operating pressure may be maintained. With the equipment as outlined a discharged battery may be replaced by a charged battery inside of four minutes, and, therefore, as two batteries are provided for each bus—one operating while

FIG. 4.—CAR BARN, FIFTH AVENUE STAGE LINE.

the second is charging—practically continuous operation can be secured.

The under-slung battery is caught or released by a lever seen at the side of the omnibus body, near the sand box, and manipulated by an attendant. The lever works on jaws or lugs which lock at each end of the battery, and which when closed hold the battery box rigidly in position under the floor of the vehicle, as shown. The bat-

tery can be charged while attached, and, in fact, that is largely being done while the plant is getting into full operation.

The New York Electric Vehicle Transportation Company, it may be added, has other work in view under its franchises, and its service through Central Park up to Grant's Tomb on Riverside Drive is one of the things that is best known among the city's pleasure trips to summer visitors. The running time from the corner of Central Park, Fifth Avenue and Seventy-second Street to the Tomb is 31 minutes, and the return 30 minutes, or just over one hour, actual travel time, and exclusive of stops at either end. The trip is a very popular one, and others like it might well be projected throughout Greater New York.

The Distribution by the Three-Phase System and the Operation of Single-Phase Circuits by It.*

BY W. L. R. EMMET.

SINCE the single-phase alternating distribution preceded the use of polyphase currents, there has naturally been a tendency to continue its use, and a full appreciation of the advantages of polyphase currents has not been acquired by many of the practical men who handle distribution problems. The first uses of polyphase currents were for power alone, the old single-phase lighting systems being unchanged. As time has gone, however, the use of single-phase apparatus has steadily diminished, and the production of polyphase apparatus has increased; and although there is still some demand for single-phase generators, an investigation will show that the best informed electrical engineers have now discarded them altogether.

An extensive experience with a single-phase, two-phase, three-phase and other apparatus, has led me to believe that for almost all purposes of lighting and power distribution the three-phase winding is the most desirable for central station generators, and that two-phase and single-phase windings have, in the great majority of cases, no good reason for existence.

It is not necessary to enumerate all the advantages of the three-phase system, but it may be said that among the reasons for its universal adoption are that the three-phase generator is better than the two-phase generator for single-phase operation, where single-phase operation is required, and further, that the three-phase generator when used as a single-phaser is practically as good and as cheap as it would be if it had been designed particularly for single-phase uses. Thus it can meet the two-phaser or the single-phase on equal terms in their own field and at the same time can afford its own special advantages.

When a three-phase generator is to be operated on a single-phase circuit, it is generally desirable to use a "Y" connected winding, although with certain types of windings the delta connection will give equally good results. With such a winding the three-phase machine, as ordinarily designed, will carry from 75 per cent to 85 per cent of its rated load in single-phase current between two conductors with the same heating which would be produced by operation at its rated capacity with balanced three-phase current. If motors or rotary converters are connected to a three-phase generator which is operating with single-phase load, these motors or converters will tend to equalize the load between phases and thus may increase the capacity of the system. When a three-phaser is partly loaded with single-phase currents between two of its wires, the unusual phases may naturally be loaded with other single-phase currents, thus giving various degrees of unbalancing between the three phases and, with normal heating, will vary from 75 per cent to 100 per cent of the total three-phase capacity.

The statement that the three-phaser will carry 75 per cent of its rated load in single-phase current frequently leads the customer to ask: "Why should I buy such a machine to deliver single-phase current when I can get a single-phaser which will deliver its full rated capacity with normal heating?" The answer to this question is that the three-phaser designed for a given single-phase output has about the same size and cost as the machine designed for single-phase alone, the apparent inconsistency lying in the fact that a three-phaser for a given output is cheaper and smaller than a single-phaser.

While purchasers of three-phase generators have frequently made special demand for large single-phase capacity, there are in point of fact, very few cases where it is necessary or desirable to operate three-phase machines exclusively on single-phase load. Companies that operate single-phase circuits can almost invariably divide their circuits roughly into groups, putting some of them on one phase and some on the others. The only portion of a lighting company's load which cannot be advantageously divided between the phases is the low tension, interconnected distributing system, if such a system is used. Even where such systems are used they never include the whole lighting distribution of the company, and there will always be outlying circuits which can be operated from other phases. There are also, in most cases, transformers for arc lighting and other kinds of single-phase load which can be put upon the least used phases, and which will thus tend to help out the balance of the system. Many purchasers think that it is necessary to buy a single-phase generator because they use single-phase circuits, whereas the approximate division of these circuits between the phases would involve no difficulty whatever.

Since the normal single-phase capacity of a three-phaser is about 80 per cent, since all motors and rotary converters tend to equalize the balance, and since there is always scattering single-phase load which can be conveniently put upon the lightly loaded phases, we may practically consider that the three-phase generator can be used at its rated capacity on any system.

If the three-phase generator is operated with single-phase load, or with seriously unbalanced load, there will generally be a marked potential difference between its phases. The phase carrying load will show the drop in potential which such load would ordinarily occasion on a similar single-phase machine; one of the disused phases will generally show a higher voltage and the other a lower voltage. With

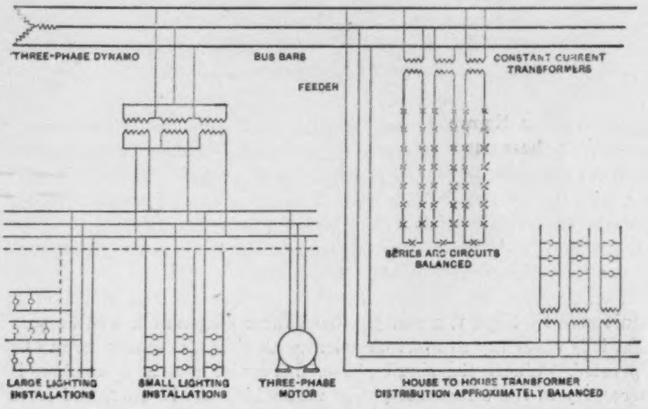


FIG. 1.—FOUR-WIRE, THREE-PHASE LOW-TENSION SYSTEM.

machines of good inherent regulation, such as are now generally used for lighting purposes, these differences are small and can readily be taken care of by regulators in feeder circuits. Where three-phase generators are operated on single-phase, three-wire distributing systems, the general practice is to regulate the generator to give the desird voltage on the three-wire system, and to control by regulators the voltage of circuits connected to the other phases. The variations of voltage on these other phases may, in some cases, be actually a convenience, since between the three phases a voltage can often be selected which will nearly suit the requirements of any feeder.

Two systems of low-tension distribution for lighting are used and recommended in connection with three-phase generators, viz., the single-phase, three-wire system and the three-phase, four-wire system. When the single-phase, three-wire system is used, the generator is generally somewhat unbalanced by the large demand for single-phase current which the three-phase wire system creates, and the voltage is regulated with reference to the needs of the three-wire system. The primary circuits are so arranged as to deliver power through transformers to low-tension network. The transformer secondaries are provided with three leads, one for the neutral and one for each of the outside wires. Since the drop in high-tension lines is small and since transformers can be put wherever they are needed, it is easy to arrange an alternating three-wire system in such a manner that it will give very perfect voltage distribution in all parts of the area which it supplies. In direct-current, three-wire systems, we naturally have to deal with large and variable feeder losses, which, in spite of the most careful arrangements, must seriously interfere

*A paper read at a meeting of the American Institute of Electrical Engineers, New York and Chicago, Nov. 22, 1901.

with the maintenance of good regulation. In alternating three-wire systems the regulation should, with intelligent handling, be practically perfect.

The other method which is available for low-tension distribution with three-phase dynamos is the four-wire, three-phase system. This system is supplied from groups of transformers, with three in each, their secondaries being connected in "Y" from a neutral. The secondary voltage of each transformer is that suitable for the lamps which it is desirable to use. In action, this arrangement is equivalent to the ordinary three-wire system, except that it has three branches

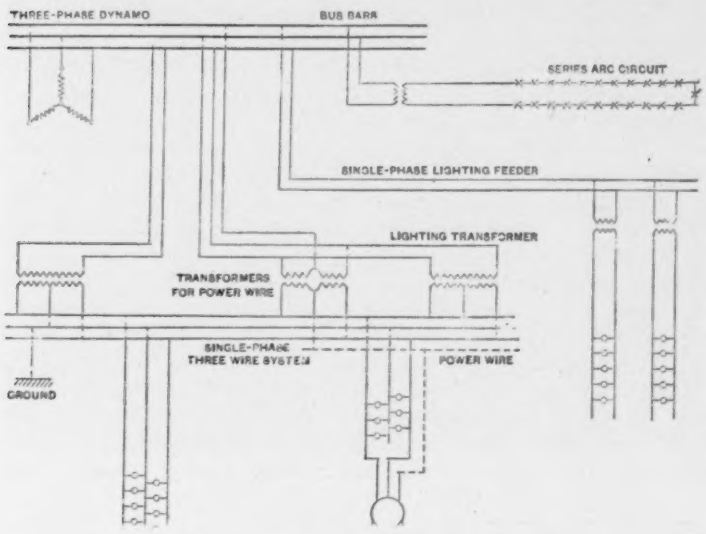


FIG. 2.—THREE-PHASE GENERATOR, WITH SINGLE-PHASE THREE-WIRE LOW-TENSION SYSTEM.

and a neutral instead of two branches and a neutral. The copper economy is practically the same in both, the advantage being slightly in favor of the four-wire, three-phase system, since the neutral need not be quite so large. This system also has the advantage that its outside wires are available for operating motors. Another advantage is that it affords a balanced load to the three-phase generators, if the four-wire system is kept in balance.

The arrangement of these methods of secondary distribution is illustrated by Figs. 1, 2 and 3. From these diagrams it will be seen that it is necessary to use four wires with either, if motors are to be operated. Where the single-phase, three-wire system is used, it is necessary to run a separate power wire which can be energized from a transformer, and which, with the outside wires of the three-wire system, affords three-phase currents for operating motors.

The four-wire, three-phase system cannot be advantageously used in all cases. Where it can be consistently used on a large scale it is probably the most desirable method of secondary distribution. It should not be used, however, where the conditions are such that the three-phase system must be seriously unbalanced by arc light transformers or other unavoidably unbalanced load. Generally, it is not desirable unless its arrangement is complete and the whole plant is arranged and operated with reference to its use. In the rearrangement of existing plants it will generally be expedient to use the single-phase, three-wire system operated from three-phase generators as described above.

In distributing electricity over considerable areas it is desirable to keep in view certain general principles in order that proper voltage distribution may be obtained. Some of the variations which affect voltage regulation are controllable from the station, while others are beyond such control, and consequently can be only partly equalized by the maintenance of a desirable average condition at the main station; even where controlling apparatus is provided in the main station the regulation may be imperfect unless considerable expense is incurred for labor necessary to the intelligent handling of such controlling mechanism. The following simple rules should always be kept in view when distribution systems are being arranged:

1st. Reduce the number of circuits to be regulated to a minimum. 2d. So arrange the system that variations not controllable from the main station are made as small as possible. 3d. Reduce the amount of total drop on all circuits so that frequent changes will not be necessary. 4th. Interconnect the load in large groups so that any variable load unit will be small in comparison to the whole of which it forms a part.

The proper application of these rules will generally lead to an arrangement where the number of feeders is small, each feeder carrying the maximum amount of power which it is desirable to transmit over a single line. Each feeder will supply a compact primary network or a set of short primary branches, the loss beyond the feeder end being small so that a good voltage regulation at the feeder end will ensure good service to all the customers connected to that feeder. To get such a result the load must, of course, be connected near the feeder end instead of being scattered throughout its length.

A method of primary distribution has been used and advocated to a considerable extent which frequently lends itself very well to the accomplishment of the results above mentioned. This system is illustrated by the accompanying diagram. The "Y" connected generator is used with windings arranged to give about 2300 volts between the neutral point and each outside wire. Such a generator may be loaded as if it were three separate single-phase machines, the neutral being used as a common return for all the circuits. The standard 2300-volt transformers are adapted to use between the neutral and any of the outside conductors. The usual method of applying this system is to run out long four-wire feeders. At the end of each four-wire feeder there may be a loop or a branching of the four-wire system so that it is brought near to all parts of the area to be supplied. The transformers for lighting purposes are connected to short two-wire branches, which connect to the four-wire feeder at or near its end, the arrangement of these branches being such as to give an approximately balanced load on the four-wire system. If the load is balanced there will be no current in the neutral. Even if the unbalancing is considerable, the drop in the neutral will be so small that it will only slightly affect the voltage conditions. Regulators can be used in the main stations in each of the outside conductors, and these in combination with compensated voltmeters can maintain the desired potential at the feeder end between each of the outside conductors and the neutral. The neutral conductor should preferably be grounded in the main station so that the maximum voltage to ground on any of the transformers will be 2300 volts.

With a rough approximation to balance we virtually have, by this system, three-phase transmission at 4000 volts, the voltage between the outside wires being about 4000, when we have 2300 volts between each wire and the neutral. The system thus affords means by which

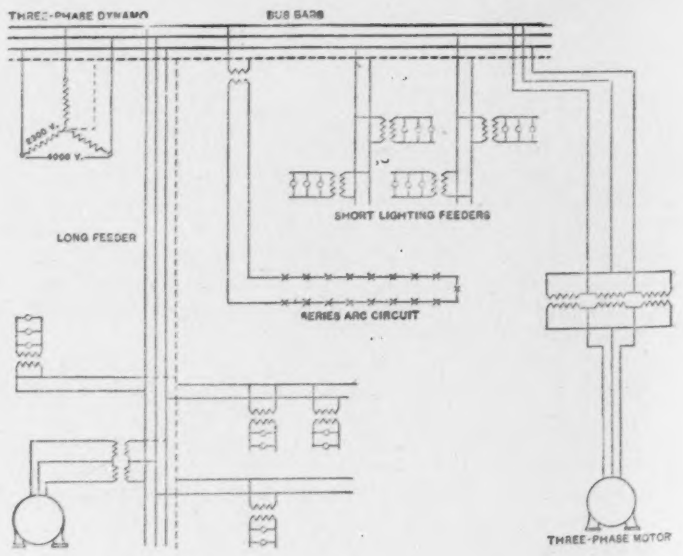


FIG. 3.—HIGH-TENSION FOUR-WIRE THREE-PHASE SYSTEM.

we can economically distribute over large areas without the use of step-up transformers.

When this system is used, it may often be desirable to operate lines in the immediate vicinity of the power station from single-phase branches instead of running out the four-wire feeders. The neutral should simply be used as a common return where convenient, and the long lines should be so arranged that the common return will be as effective as possible. Wherever motors are used it is, of course, necessary to get access to all three of the outside conductors.

The great improvements which have recently been made in auto-

matically regulated three-phase generators have made it economical and desirable to use such machines in many cases where direct-current apparatus would heretofore have been adopted. The alternator is simpler, more efficient and less liable to trouble than the direct-current machine, and it is often desirable to use it even where long-distance transmission is not required. There are also many cases where the principal loads are found in the immediate vicinity of the installation, but where there are certain long branch lines which it is desirable to operate at high voltage. If low-tension alternating-current generators are used, such transmission lines can always be taken care of by step-up transformers. The system recommended for such low-voltage alternating distribution is the four-wire, three-phase system operated from a low-voltage "Y" connected alternator. The winding of the alternator is such that the voltage of lamps is provided between its neutral and its outside wires. A four-wire network is supplied from the machines through suitable feeders, the lights being operated in approximate balance between the outside wires and the neutral, and standard motors being connected to the outside wires where desired. If the standard 220-volt motors are used the desirable lamp voltage will be about 125, and with 440-volt standard motors 250-volt lamps will generally be suitable. The system of distribution with the higher voltage can be extended over considerable areas with small expense for copper, and is very desirable for mill lighting and many other purposes.

Such low-voltage alternating work is desirable for railroad yards, summer hotel properties, colleges, private estates and other similar installations.

New Telephone Patents.

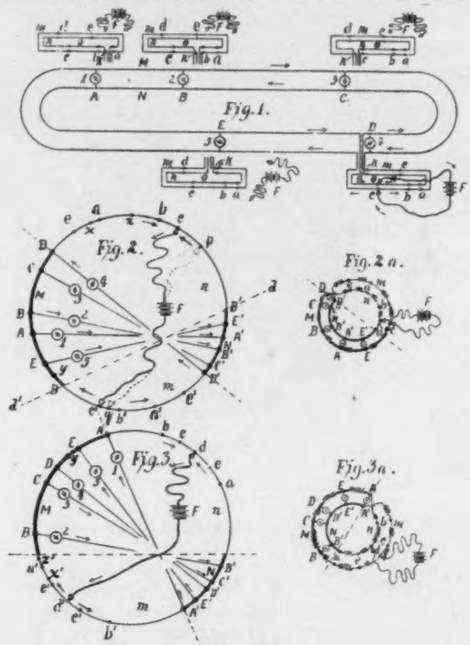
Of the making of telephone receivers there is no end. Of the seven telephone patents of the issue of Dec. 3, four are granted to the same same inventor for novel designs of receiver. In the early days of telegraphy it was said that every telegraph engineer had invented an insulator. Since Bell's invention was disclosed to the world almost every man connected with telephony has devised some kind of variation of the familiar elements of the magnet telephone, and this notwithstanding the fact that any mechanic can put together on standard lines a telephone that is the most sensitive electrical instrument known, and practically from the beginning of telephony has been impossible to improve on, except in minor details of construction.

The most important patent of the issue under consideration is that granted to Mr. Sylvanus Albert Reed, of Middletown, N. J., on a selective system, which not only operates on a novel principle, but has been most ingeniously and thoroughly worked out in its practical application. The systems for selective signaling heretofore known and used are classed under three heads—first, those known as the "step-by-step" systems, in which step by step mechanisms at the subscribers' stations are controlled from the central station in such a manner as to enable the operator to pick out or select the desired station and ring its bell to the exclusion of all others on the same line; second, those known as the "strength" and "polarity" systems, or that class of selective calling devices which depend for their operation on changes in the strength or in the direction of a current or on changes in both; third, those known as the "harmonic" systems, in which a vibrating reed is made to take up its vibration by the action of a succession of impulses of force occurring in the same period as that peculiar to the reed which it is desired to operate. With all of these systems various well-known fundamental objections are associated, of which it may suffice to mention the limitation in the number of stations in the strength and polarity systems and the excessive number of moving parts and delicate adjustment in the receiving apparatus of the other two systems.

Mr. Reed's invention does not fall properly in any of these classes, but is based upon a distinctly new and original application of the principle of the well-known Wheatstone bridge. In the application of this principle to a selective system of telephone circuits, Mr. Reed has devised novel arrangements of circuit and novel apparatus. Mr. Reed claims that on his system a two-wire loop may be used for an indefinite number of stations, limited only by convenience; any station may appropriate the line, may call up any other station exclusively, maintain exclusive communication with it and afterwards restore the line to a normal condition ready for similar use by other stations. During the use by one pair of stations no other station can cut in or overhear, except that a supervising station may be provided with the means of so doing, if desired. The system operates either on a strictly metallic circuit or on a partially grounded circuit, and it may be operated either with local or common sources of current or batteries, and may utilize the telephone instruments in current use.

Figs. 1, 2 and 3 are diagrams illustrating the principle of operation, and Fig. 4 is a diagram of a working line, Figs. 5, 6 and 7 showing enlarged views of details of the apparatus. Fig. 1 is a diagram of a five-station line on the Wheatstone-bridge principle, and Figs. 2 and 3 are graphical diagrams of the electrical circuit employed. In these diagrams relative resistances are represented by relative lengths. In Figs. 2 and 3 the circuit is seen to consist of a loop, *M m, N n*, shown as a circle, and a source of current *F*, which may be connected to the loop by conductors with shiftable contacts, shown in Figs. 2 and 3 as small pointed heads. Connection being thus established, current will pass into the loop at *C'*, say, and will divide, following the direction of the arrows, part of it passing around the loop on the branch *C' M c*, and the rest passing around in the opposite direction on the branch *C' N c*. The current reunites at *c*, where it leaves the loop.

The loop thus constitutes two derived branches in multiple in the circuit. Now, if the bridges be extended across the loop between the branches thereof, as at *AA', BB', CC', DD', EE'*, it is readily understood from the principle of the Wheatstone bridge that these bridges will permit a portion of the current to pass from one branch of the circuit to the other, depending on the differences in potential at the respective extremities of each bridge. If one bridge (say, *CC'*) be



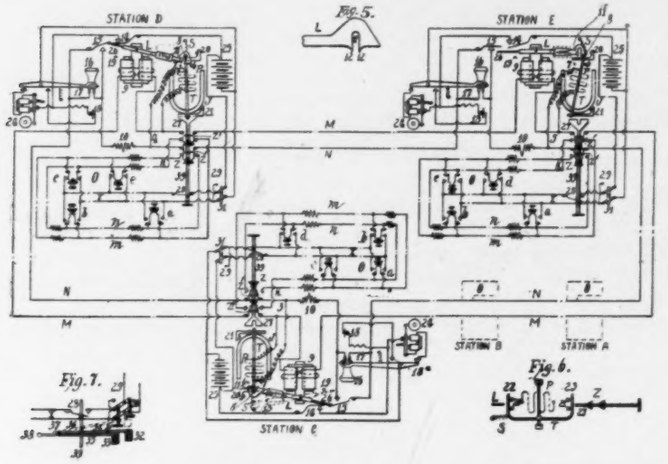
FIGS. 1, 2 AND 3.—REED SELECTIVE SYSTEM.

so related to the point of entrance of the current into the loop that its respective extremities are at points of equal potential, no current will pass and that bridge will be neutral, while all the other bridges will pass current and be active. By interposing a current-indicating device, such as a galvanometer, in each bridge it may be seen which bridge is neutral and which are active. In the diagrams these galvanometers are indicated by the numerals 1 to 5. Now, if the current supplying points are shifted along the loop from the points *C' C* to the points *d' d*, say, and if the location of the points *d' d* with respect to the bridge *DD'* has been predetermined to produce an equality of potential at the extremities of such bridge, then upon the passage of current into the loop at the point *d'* and its division about the respective branches thereof (see Fig. 3), the bridge *DD'* will become neutral, while the previously neutral bridge *CC'*, together with the other bridges, will become active, the conditions in the respective bridges as to activity or neutrality being indicated by the galvanometers, as before. By ascertaining throughout the loop the location of pairs of points, each pair having the special definite relation to one of the bridges that current from it will cause the related bridge to remain neutral, while all the other bridges become active, it follows that the operator is given the power absolutely to select and to control the electrical condition of any desired bridge as to

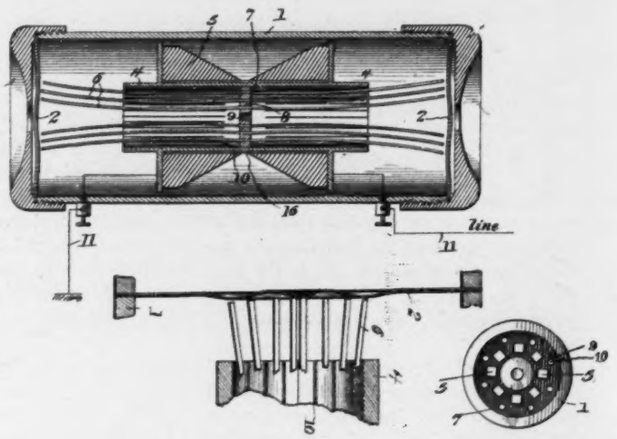
neutrality or activity by simply applying current at the appropriate contact points. The contacts represented on Figs. 2 and 3 by *aa'*, *bb'*, *cc'*, *dd'*, *ee'*, have been thus determined with this special relation to the respective bridges *AA'*, *BB'*, *CC'*, *DD'*, *EE'*.

In practice the circuit becomes an endless coil of two turns, in which the bridge extremities and contacts for the source of current instead of being remote from each other become adjacent and assume the proper and convenient sequence. Fig. 1 is a general diagram of the practical selective circuit preferably adopted, and Fig. 2a shows how it is developed from the graphic diagram of the circuits, Fig. 2. Fig. 2a shows the loop folded into a double coil, bringing the heavy lines or bridge segments together, and the light lines or contact segments together, the coil then consisting of the defined bridge region *MN*, and the contact region *mn*. If the double coil is now constricted at the points cut by the dotted line it will assume an hour-glass form instead of the circular form shown. If next the region shown in light lines be made of material whose specific resistance is high compared to that of the region in heavy lines, a construction is obtained which may be developed into the form shown in Fig. 1. In this figure the neck of the hour-glass is shown at *K*, the loops *MN* and *mn* being the respective bulbs of the hour-glass and representing the parts indicated by the same letters in Figs. 2 and 2a.

The circuit consists of an external line *MN* with stations *A B C D E*. Each line *M* and *N* forms in the normal condition of the line a closed loop. At each station is a bridge connecting the two wires *MN* in multiple. Each bridge includes a signal or motor device, indicated by the numerals 1 to 5. At each station is a pair of local conductors *O*, normally disconnected from the line, also a source of current. The local conductors *O* correspond to the regions *mn* of the graphical diagrams. They constitute the selective calling or signal-transmitting apparatus and are made up preferably of high resistance material, each being usually of somewhat greater total resistance than one of the wires *M* or *N* of the external line. The local conductors form each in a certain sense a miniature reproduction of the external line. Each set of local conductors has a sequence of pairs of predetermined contacts *a b c d e*, brought into a convenient position on a keyboard to facilitate the making of electrical connections therewith, and the intermediate portions of said keyboard conductors are coiled into a compact space. The pairs of contacts on the various keyboards are carefully located with a definite relation to the various bridges across the line, so that for each bridge in the line there is a related pair of contacts on each keyboard.



FIGS. 4, 5, 6 AND 7.—REED SELECTIVE SYSTEM.



FIGS. 8, 9 AND 10.—LIEBREICH RECEIVERS.

The keyboard conductors are arranged so that they may be looped into the external circuit according to some one of several different methods, all of which accomplish in different ways a similar result—the production jointly with the external line a single resultant combined circuit, in which by adjustments and connections selectively made at the predetermined keyboard—contacts a current of electricity when applied will so divide that at every station except the one selected there will be set up at the junctions of its bridge with the line wires a difference of potential, whereas at the selected station such difference of potential will be zero. Considering any one pair of contacts as the points of entrance and egress, respectively, of an electric current into and out of the loop, it will be found that during the passage of a current through them their related bridge joins points on the loop which are of equal potential, and such bridge is, therefore, neutral, while every other bridge joins points on the loop of different potential and is, therefore, active.

In putting his method practically to work on telephone lines Mr. Reed adopts a relay, in series on one of the lines, which at the station selected clamps the telephone circuits in operating contact and at the non-selected stations displays a "busy" indicator and locks the stations out of circuit. This is effected by a mechanical relation between the selective signal and the relay armature; the station outfit is a fairly complicated collection of apparatus as will be manifest by a study of Figs. 4, 5, 6 and 7. In Fig. 4 *M* and *N* are the looped line wires, passing through five stations, of which three are shown in detail and two merely indicated. The keyboard sets are indicated at *O*, and *Z* are the switches for looping *O* into the main line; 3, 4, 5 are the bridges at stations *C D E*, containing the selective signals *P*; 9 are polarized relays in series on line *M*, and 10 non-inductive resistances in line *N* to balance relays 9. The selector consists of a high-resistance helix *P*, pivoted in the field of a permanent horseshoe magnet *J*. The helix *P* carries a light arm *T*, which plays between stops 6 and 7, and is restored to rest by the spring *S*. Relay 9 has a rocking arm *L* attached to its armature, which is limited in its play in one direction by the stop 19. Arm *T* has at either end a flexible and elastic extension 22, 23 (shown in Fig. 6); 22 plays in front of *L* so that it will block *L*'s descent if 22 has deflected, but if it has not deflected will engage in notch 11 (see Fig. 5), and permit *L* to descend. When *P* at any station is neutral (consequently selected) 22 does not deflect and the relay 9 being energized, *L* is thrown over, engaging 22 in notch 11 and closing the bell circuit at 14 and opening the contact at 15, which normally short circuits the telephone set. At the non-selected stations *T* deflects and 22 is carried over past notch 11 on *L*, and so locks *L* in such position that it cannot operate the bell and telephone contacts. This position of *L* also serves to show a "busy" indicator at the locked stations. A reverse current through the relays throws *L* up and allows *T* to return to its normal position. The switch *Z* mechanically locks *T* in the zero position at the calling station by the depression of the fork 27, which engages in arm 23 of *T*. This allows the relay to throw in the telephone circuit at the calling station. In Fig. 4, station *D* is shown calling station *C*, and it will be noticed that the two telephone sets are by the action of the relays looped into the non-inductive line *N*, which becomes the telephone line proper when communication is established.

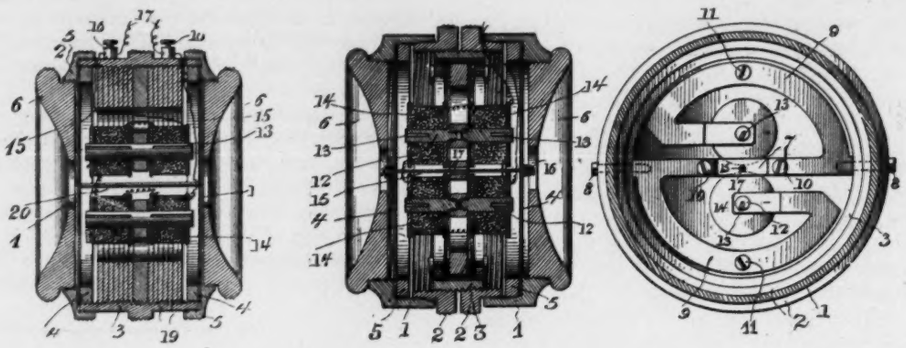
The switch *Z* when up leaves *M* and *N* continuous, and when down cross-loops in the keyboard conductors *m n*, and also throws battery switch 28 and reversing switch 29. In practice, the holes or openings for the keyboard plugs are brought together in a row, each marked with its number. The resistances forming the keyboard conductors are preferably coiled into a compact space below the keyboard. A single contact plug may be used for all the calls, and may be left in the hole last used, since the battery current is controlled by switch 28 and the keyboard is connected with the line only when *Z* is depressed. In Fig. 7 is shown a device whereby the reversing switch 29 is in-

terlinked with switches *Z* and 28, so that all three switches are operated jointly and in proper sequence by a single operation for calling and disconnecting.

This invention takes eight pages of specifications and ten pages of claims, the claims numbering 56, to describe and protect. It is undoubtedly a most ingenious idea, and has been most cleverly worked out. Whether the complication and expense of the station apparatus, the difficulties of installation and the line costs incidental to building the lines in a continuous loop through all the stations will allow of its extensive adoption are points for practical demonstration.

Mr. Hans Liebreich, of Detroit, Mich., to whom a small family of patents on telephone transformers was issued on Oct. 8, now follows on with a quartette of patents on telephone receivers. The receivers bear a strong family likeness to the transformers (see ELECTRICAL WORLD AND ENGINEER, page 645, issue of Oct. 19, 1901), and from one of the receiver specifications we derive the interesting information that Mr. Liebreich has christened his improved transformer by the euphonious name of "magnozine," and that a Liebreich "magnozine" greatly improves the action of a Liebreich receiver.

Figs. 8 and 9 show one form of improved receiver, consisting of separate bar magnets held by a block within a split iron core or tube which is surrounded by the coil. The magnetizing of the split core reacts on the magnets, causing them to diverge and vary their pull on the diaphragm, with the startling effect on the latter depicted in Fig. 9. Another form of receiver, the subject of a separate patent, has concentric magnets, the center magnet only carrying a coil, the structure being such that "a series of concentric vibrations" will be produced on the diaphragm. A cross section of this receiver is shown in Fig. 10, looking at the tops of the magnets, 7 being the coil on the central magnet and 55 the tops of the surrounding bar magnet; 10 are apertures in the supporting block to allow air to circulate between the two diaphragms. The third of this interesting family of receivers is of watchcase form (Fig. 11), and has two diaphragms mechanically connected in tandem. The magnets are built up with rings, but only one pair of poles is presented to each diaphragm, each pole piece, however, having two coils on it. The fourth of the quartette is a watchcase tandem diaphragm receiver with specially shaped magnets, whose strength may be altered by means of adjustable leaves or plates. Figs. 12 and 13 show fairly clearly the general construction of this receiver. It does not appear from Mr. Liebreich's specification how the double diaphragm is to be availed of usefully in practice.



FIGS. 11, 12 AND 13.—LIEBREICH RECEIVERS.

A patent is granted to Mr. John Ainsworth Rice, of Bland, N. M., on a telpehone attachment, whose object is to operate a local electric bell circuit by means of a circuit closer set in action by the hammer of a magneto telephone ringer. The purpose of this device is to provide a loud alarm bell for the telephone in such places as machine shops. The arrangement of the circuit closer, as illustrated in the patent drawings, appears to have the defect that it would always keep the local bell circuit closed, no matter what the position of the magneto ringer.

Another patent of doubtful utility is issued to Mr. T. B. Lee, of Charleston, S. C., on which is termed by the inventor an "automatic monitor for telephone exchanges." This appliance consist sof a pencil mounted over a moving band of paper, and adapted to be brought in contact with the paper by an electromagnet included in the night-bell circuit of a telephone switchboard. The pencil would make a line on the paper corresponding in length to the interval between the moment of the subscriber's call and the moment of the operator's answer, as indicated by the replacement of the drop. It is conceivable that a device of this sort, placed under lock and key in a small exchange, might act as a sort of automatic night watchman to keep tally on the promptness of the operator in answering night calls, but to term it an "automatic monitor" is somewhat of a misnomer, in view of the modern telepohnic meaning of the word monitor.

The Telephone in French Drama.

The use of the telephone on the stage is not new. One early instance of the use of it is in Bronson Howard's "Henrietta." A more recent case is the rather vulgar comic opera, "The Telephone Girl," in which Mr. Louis Mann is genuinely funny. It is now noted from Paris that of the six new plays last week, one produced at the Theatre Antoine, written by De Lorde and Roley, and entitled "Telephone," deserves special mention, because it owes its extraordinary success to absolutely novel construction, and presents melodrama in a phase of modernity which, in Paris at least, has not hitherto been attempted. A husband hears through the telephone his wife and children being assassinated in a deserted country house 80 miles distant. In the cleverly and realistically staged first act we see the husband taking a hasty leave of his family. He shows his wife a revolver in a drawer for use in case of emergency and confides his family to an old and trusty servant. He promises to telephone during the evening and departs. Afterward a messenger arrives with a letter summoning the old servant away to his mother's deathbed. The messenger, left alone for a moment in the hall, takes note of the premises and steals the revolver. The wife, daughter of 20 and infant get nervous toward sunset and think they hear steps in the garden. To cheer them up they telephone to the husband and the curtain falls.

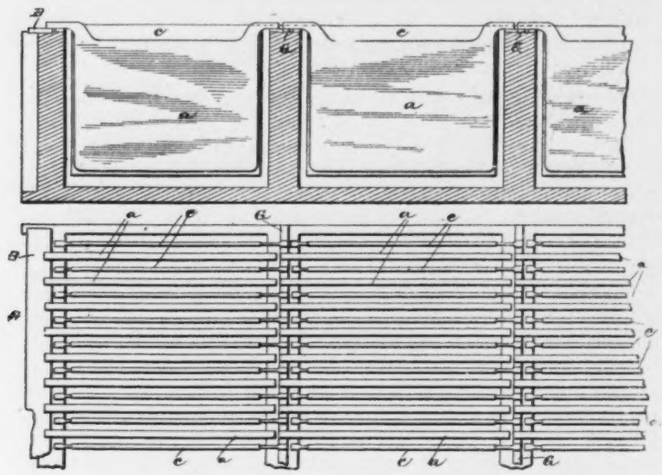
In the next act we are at the other end of the telephone. The husband, called up by the wife, exclaims: "What, you say you hear footsteps in the garden? What nonsense! Anyhow, you have the revolver. What? The revolver is no longer in the drawer?"

Antoine, who plays the part of the husband, thus relates each detail of a terrible murder, as it comes to him over the telephone. Antoine's exclamations as he hears the steps, hears the door open, hears the murderers approach his wife and children, hears their struggles and death wails, and when he quits the telephone and breaks forth into unearthly screams and goes mad, all this has a tremendous effect on the audience, and is the Parisian actuality of the moment, causing the critics to ask: "Is this the melodrama of the future?"

The opinion of the public seems about evenly divided. Some say yes, others most emphatically no. Anyhow, Antoine's realistic innovation causes a sensation, and an effect such that during the first performance, on Thursday night, it is stated by the Paris correspondent of the *New York Tribune*, a woman whose literary attainments are appreciated on both sides of the Atlantic, and near whom he happened to be seated, was seized with an attack of nerves, and, unable to master her emotion, had to be carried away from the theater.

Electric Connections for Refining Plant.

A patent issued Dec. 3 to Arthur L. Walker, of Perth Amboy, N. J., is of interest as disclosing the system of electrical connections employed at the works of the Guggenheim Smelting Company, in Perth Amboy. As diagrammatically illustrated in longitudinal vertical section and in plan, the refining tanks are arranged side by side, the anodes and cathodes, *a* and *c*, in each tank being connected in multiple while the several tanks are arranged electrically in series.



CONNECTIONS OF COPPER REFINING TANKS.

This is effected by allowing the cathodes of one tank and the anodes of the next to rest upon a single distributing bar *G*, lying upon the dividing wall, whereby the current passes directly from the cathodes of the first tank to the anodes of the second, and so on throughout the entire series.

It is stated that this simple device results in saving more than 80 per cent of the copper employed for conductor bars under the best prior practice. For instance, for a current of 4000 amperes a leading-in conductor, *B*, of five square inches cross-section, and a leading-out bar of the same dimensions are used; but these are the only heavy conductors employed, for as will be at once seen, the intermediate or distributing bars *G* carry for each unit of their length only a fraction of the current represented by the reciprocal of the number of cathodes in the tank, or, say, 5 per cent; these bars need, then, be only ½ inch in diameter.

In conceding the magnitude of this improvement in refining practice one can scarcely fail to be struck by the apparent crudity of design which has left so simple an expedient so long uncovered.

Experiments in Wireless Telegraphy.

We noted recently the intention of Mr. Marconi to visit Newfoundland to make some experiments in wireless telegraphy from balloons. He has reached St. Johns, N. F., and is quoted as follows in regard to his work there: "My principal object is to make experiments so as to ascertain the relative values of different positions along the coast, with the view of locating one of our stations near St. Johns. I have brought with me two balloons of about 15,000 cubic feet capacity. They will be used to suspend the vertical wire and should be valuable for experimenting on account of their portability. The ordinary pole used in permanent stations is about 180 ft. high, weighing about five tons, and it would consequently be difficult to carry one around for experimental purposes. It is proposed to make the first tests at Signal Hill from the Cabot Memorial tower, where the Government has allowed me the use of two rooms for storage of my apparatus.

"In making these experiments I shall closely study the rock formation of the coast, as if it is found that good results can be obtained in Newfoundland, the knowledge gained about the physical character of the ground will be a guide to me in locating stations elsewhere. One has to study geology very closely in these matters. Before erecting a plant it is necessary to test the ground thoroughly and ascertain whether the soil is suitable, as certain kinds of rock formation are more favorable than others, better results in the way of long-distance signaling being obtained. Some of these scientific experiments might perhaps have been carried out in England, but it occurred to me that the tests could be made better here, and, as it is proposed to erect a permanent station near St. John's, I decided to come over and conduct the experiments in person.

"After two or three tests have been made at Signal Hill I intend to move the whole apparatus to Cape Spear, about five miles south of St. John's, and experiment there, afterward making comparisons between the tests. I would like to say that the Newfoundland Government is doing everything possible to assist me. The Governor, Sir Cavendish Boyle, and his Executive Council are much interested in the experiments, and they have offered me the use of any lighthouses on the coast for storage and other purposes while we are at work.

"At present there are 40 stations fully equipped with wireless telegraphy apparatus in different parts of Europe, and we have also five in America. All Lloyd's stations are now being equipped, and the system is in use on about 40 ships of the British fleet, as well as the Cunard and other first-class mail steamers. It is with one of these latter ships that we shall probably communicate with while here.

"I hope before we leave to be able to receive and send messages 250 to 300 miles or even further, but, of course, I cannot definitely say what may be done, as the weather may have a detrimental effect on the experiments. I expect, however, to obtain better results here than from any previous tests. According as the experiments are made we shall be glad to let the public know the results. After Signal Hill and Cape Spear have been tested I shall probably proceed to Cape Race and make similar tests there, and when we have decided upon the most suitable location a permanent station will be erected. The question of the establishment of wireless telegraphy at St. Shotts has nothing to do with the tests referred to, as I do not think a station there will be necessary if we have one located between St. John's and Cape Race. At the same time the Government may decide to erect one there.

"The Canadian Government has already a plant working at Belle Isle, in the Straits. It has been in operation about three months, but it has not yet, as far as I am aware, made communications with passing ships. No doubt it will do so regularly next season. The station is in connection with the system of telegraphic extensions on the Canadian portion of the Labrador coast, which was undertaken this year. It will undoubtedly be a boon, not only to Newfoundlanders, but to the whole world, if a station is erected near St. John's."

Underwriters' National Electrical Convention.

At the recent meeting of the Underwriters' National Association action on several important subjects discussed was put over until after conference with the Code Committee of the American Institute of Electrical Engineers. Among these are the proposed rules for high-potential transmission lines of over 3500 volts. The proposed rules specify that no overhead line carrying more than 3500 volts shall be allowed within 75 ft. of any building, with a proviso that deviations from this rule in the case of isolated property on country streets or roads may be applied for. Another rule is that such high-voltage wires shall not be allowed on the same pole with other wires, nor on the same side of the street or road with pole lines carrying other wires. Finally, it is recommended that when such circuits are overhead they should be run over a private right-of-way and all poles stenciled with the words, "Danger, —— Volts."

Another matter referred to the A. I. E. E. committee relates to high-voltage motors. Proposed rules specify that motors operating on a voltage of 200 or more shall have the switch house located outside the main building, in which shall be placed the main switch, lightning arresters and cut-outs. Motor frames and lead-sheathed cable are to be thoroughly grounded; all switches to be of the oil type and all instruments to be operated from transformers and not connected direct to the line. Motors connected to any circuit having a difference of potential between any two wires of over 750 volts, must not be placed inside the main buildings, except in the case of large machines, when the apparatus must be so located as to reduce the amount of inside wiring to a minimum.

A letter was also referred for conference with the A. I. E. E. committee, asking for modification of the rules with regard to

grounding low-potential circuits, so that the ground might be on one side of the circuit instead of at the neutral point of the transformer.

The Association directed the attention of various inspection departments to be called to the fact that under the National Electrical Code link fuses are only allowed in a few specified cases. In general, the use of other than plug or cartridge fuses is limited to enclosed cabinets, main switchboards or other locations where the flash produced when a fuse melts can do not harm.

A recommendation was adopted concerning the minimum allowable distance between bare bus-bars and similar bare live metal parts of opposite polarity on switchboards and tablet apparatus. It is recommended that up to 250 volts the allowable minimum distance up to 100 amperes shall be 1¼ inches; from 100 to 300 amperes, 1½ inches, and from 300 to 1000 amperes, 2 inches; at voltages from 250 to 600 the distances becomes respectively 2½, 3 and 4 inches. Very full specifications are given for plug and cartridge fuses, the number of heads being 15. Twelve specifications are proposed with reference to rheostats, theater dimmers and main line regulators.

Concerning the present rule for slow-burning weather-proof wire, it was pointed out in reply to a criticism that manufacturers who wish to manufacture wire with an outer weather-proof coating can do so if the slow-burning compound is used underneath.

Telephony on the Pacific Coast.

The United States census of 1900 figured out shows the following percentage of telephones to population, in exchanges of 300 or more subscribers of the Pacific States Telephone & Telegraph Company as of Oct. 31, 1901:

	Population.	Subscribers.	Percentage.
San Francisco	342,782	27,878	8.13
Los Angeles	102,479	10,440	10.19
Oakland	96,638	7,716	7.98
Portland	90,426	8,083	8.94
Seattle	80,671	5,873	7.28
Tacoma	37,714	3,128	8.29
Spokane	36,848	4,282	11.62
Sacramento	29,282	2,391	8.17

These are generally higher ratios than obtain in other parts of the country, as shown by a fuller table given in these columns a few months ago.

A Telephonic Money Order System.

Considerable space was devoted in the last issue of ELECTRICAL WORLD AND ENGINEER to a discussion of the proposed utilization of the telephone for money orders and transfers. A number of interesting opinions were presented from telephone managers and experts, both Bell and independent, from all parts of the country. We are now able to add one or two more. Mr. George F. Trier, secretary and general manager of the National Telephone & Telegraph Company, of Fort Wayne, Ind., writes us: "I do not know how desirable a money order system by telephone would be. In this part of the country nothing of this kind has ever been attempted. We have, however, transmitted money over our system by telephone, where the parties desiring to send and receive such money, call at the respective offices and the sender deposits the money with the company's operator and the company's operator instructs the operator at the other end to pay out to the proper party the amount, taking proper receipt. This has not been done very extensively, however." Mr. C. S. Bash, a well-known commission merchant of Fort Wayne, is connected with the same company as treasurer, and has long been known for his active work in the "independent" field and his desire to promote telephonic improvement. He says: "I am connected with the National Telephone Company, of this city, which is the long-distance toll line company covering a large portion of the northern part of this State, and have been looking into the subject which you refer to quite a little. I am free to say that I believe that a telephone money order system is practical and could be used to advantage. It would be necessary to have first-class operators in charge of this department, who were thoroughly skilled in telephony. In addition to this the management would have to be such as would ensure with reasonable certainty the identification of the parties. I believe the plan is feasible." The subject is certainly an interesting and important one, and we shall be glad to hear further from any of our readers in regard to it.

Mr. Kempster B. Miller, the well-known authority on telephone matters, says: "I have had very little time to think out the matter, which is entirely novel to me. I have never heard of anything of the kind before. It seems to me that the great difficulty would be in the proper identification of the persons sending the order. Of course, in the case of the telegraph, the telegraph company has the exclusive control of its wires, while in the case of the telephone, the public has control of the wires. I am not prepared to say that the scheme is in any wise infeasible, but it does seem as though a very elaborate system of identification would have to be introduced."

The Telephone in the South.

The independent telephone interests in the South appear to be in a flourishing condition, from the fact that failures of exchanges of any size are of the rarest occurrence. The leading feature might easily be said to be the tendency towards uniting interests on the part of the independent exchanges. The prediction is made by a leading telephone man that within a few years not only the South, but the entire country will be controlled as to its independent interests by a single corporation with headquarters probably in New York.

The independent interests are already showing a tendency to combine, thus saving largely in running expenses. This fact is well illustrated in eastern North Carolina, where some seven exchanges in as many cities have now combined.

A leading point of difference between the Bell and the independent systems in the South is that the Bell has at present almost a monopoly of the long-distance service, while the independent interests are reaching the local fields, and small towns and making country connections which will eventually be of great value in developing the section. Some of the independent companies in the larger centers already have the territory well covered for a radius of from 20 to 100 or more miles.

There are several points of interest, regarding the fight between the Bell and independent systems, which characterize the South as compared with other sections, according to an independent telephone man. "The most important one is in the matter of rates. The Bell company seems to have offered lower rates in the South than elsewhere, thus rendering competition sharper, and the independent system has a hard row to hoe on this account. If the small systems unite they can give much better service and make many needed improvements, especially where they are barely existing under present conditions."

While it is not the policy of the Bell company to discuss its plans, still the work accomplished has assumed large proportions in the South, where this company now offers the only long-distance service in the field at present. The Bell people believe in expansion in the South, and are carrying out this policy to its fullest extent. While the Bell company does not attempt to reach to any extent the smaller hamlets, the large centers are all covered, and as the smaller towns grow to a sufficient population the Southern Bell is generally found on the field establishing an exchange.

New Power Plant for Seattle, Wash.

Most labor-saving devices known to modern engineering will be used in the new power station, now being erected for the Seattle Electric Company, of Seattle, Washington. Megrath, Gribble & Duhamel are the contractors for the building, and the American Bridge Company for the steel work. Engineer Hanford, of the firm of Stone & Webster, has charge of the construction. This building which will furnish current for the entire electric lighting, railway, heat and power system controlled and owned by the above company, is 108 ft. square, situated at the intersections of Yeslar, Way, and Western avenues. The materials used in its construction are steel, stone, concrete and pressed brick. The structure will be absolutely fireproof as far as it is possible for one of its kind to be. Over 1000 tons of structural steel will be used in the building, as floors will be constructed of concrete and expanded metal. The building rests on a solid foundation of 4000 piles, on which is built a solid foundation of concrete 8 ft. thick. A granite bulkhead will keep the waters of Puget Sound from reaching the pilings in the foundation. The main

floor of the building will be 10 ft. above the level of Western Avenue, and will be occupied by the engines and electric generators. A room 52 by 108 ft. in area, running clear to the roof, 60 ft. above, will be occupied by the steam engines. The plant to be installed in the engine room at present will consist of two vertical cross-compound McIntosh & Seymour engines, each havnig a rated capacity of 4000 hp, coupled direct to Westinghouse alternating-current three-phase generators. Each generator will have a capacity of 2500 kw, capable of being increased in an emergency to a little over 3000 kw. One of the features of the engine room will be a large 50-ton electrical traveling crane.

On the Post Street side of the main floor there will be located a number of transformers and rotary converters. Directly above this room will be a pipe gallery and ash conveyors. The piping system of the station will be very complete and unusual for Western power construction. Steel and gun-metal castings will be used for all high-pressure work, and bronze fittings and brass pipes for all feed-water piping about the station.

The next story will be 40 ft. above the street level, and will be used for the boiler room. On this floor are located three batteries of Babcock & Wilcox water-tube boilers, which will supply steam for the engines, pumps, hydraulic elevator service and the heating system. Over the boiler room will be the fuel room, the feature of which will be a Berquist suspension coal bunker, with a capacity equal to 24 hours' supply. The coal will be carried to this bunker by automatic conveyors taking it from the street below, and will be fed from the bunkers through chutes to the hoppers of automatic stokers. The waste gas from the boilers will be discharged through a steel stack 195 ft. high and 12 ft. in diameter. The draft through the stack will be assisted by a large steam-driven exhaust fan. When finished, the station will represent an investment of over $850,000. It is expected the plant will be in operation by February, 1902.

Elocutionary Training for Telephone Operators.

In view of the reports that have been going the rounds of the daily papers recently in regard to elocutionary training for telephone operators, it may be of interest to review the system of training and examination which the Chicago (Bell) Telephone Company has practiced for the past six years. Applicants for the position of operator must first pass an examination in hearing, quickness of perception and good enunciation, before they will be further considered as candidates for the position. For this purpose a dummy switchboard is used, and three examiners converse with the applicant; the chief operator listening in meanwhile. The examination, which lasts about 15 minutes, is for the purpose of bringing out several points. The matter of distinct enunciation, while important, is probably the thing that is most easy to secure in an operator. The general tone of voice in the use of the rising inflection is taken note of. It has always been the aim of the company to get operators who would carry on conversation in a pleasant tone of voice. But the point which needs to be looked after most closely, according to Mr. Hibbard, is that of perception. A girl may be able to hear and talk perfectly well, but if slow in perception—that is, slow to catch a conversation or number, and slow to act upon what she hears—she is not a desirable candidate. Quickness of perception is dependent partly on previous training and temperament, and partly on nationality. A large percentage of the operators in the Chicago Telephone Company's exchanges are American girls of Irish parentage, as these are found to have to the highest degree the necessary quickness of perception and action. Girls raised in the city are also found to be better in this respect than those raised in the country. In addition to passing an examination at first, operators are examined from time to time to satisfy any possible doubts as to their competence to continue in their positions.

The New Long-Distance Telephone Company, of Indianapolis, has also adopted the innovation of having its operators undergo training in elocution. President S. P. Sheerin states that the matter of giving the operators lessons in elocution has been turned over to Mrs. Edward W. Fenger, who is a very capable elocutionist of that city, a graduate of the Boston School. The young ladies take their lessons in her schoolroom at such times and in such numbers as her convenience and theirs will permit. Mrs. Fenger has condensed her course and methods to meet the requirements as nearly as possible of long-distance operators, to enable them to give quick and satisfactory service in operating. The instructions cover the points of correct breathing, vocal delivery, articulation, reserve force, pitching the voice and acuteness of comprehension or perception. Mrs. Fenger has noticed gratifying progress by her pupils since the work began, and President Sheerin says that there is a marked improvement in the service. He is certain that when the training shall have been completed, the young women will do their work not only with very much greater satisfaction to the company's patrons, but with very much greater ease and comfort to themselves. The training is, of course, at the company's expense, and will apply to all new operators as they are enlisted.

Telephonic Extensions in the Rocky Mountain States.

Through the courtesy of Mr. George J. Wallace, president of the Rocky Mountain Bell Telephone Company, whose territory comprises the States of Montana, Idaho, Wyoming and Utah, with headquarters at Salt Lake, the writer learns that the prospects for a busy season during the coming year are very flattering. The company will double the size of its present building at Salt Lake and install a new and modern switchboard with a central station energy plant at Salt Lake. It will also erect a fine exchange building with all modern improvements, at Cheyenne, Wyo., to provide for its rapidly increasing business in that territory.

In reference to the business for the ensuing year, Mr. Wallace said: "Our lines and circuits now extend from the Colorado line south of Cheyenne through the entire State of Wyoming, north through Eastern Idaho, then through Western Montana and the Pan-Handle, or Coeur d'Alene region of Idaho, to the Washington State line just east of Spokane, with lines radiating this territory in almost every direction. It is surprising to note how parts of this unsettled country, taken up only by mines, have compelled the erection of long pole lines to the mines and mills, thus connecting up their properties with the Salt Lake exchange, where direct communication may be had with the stock exchange and smelters. We have built this year so far 2100 miles of toll lines, which has added about 50 per cent to our exchange subscribers. This increase of subscribers has been brought about by the following extensions: Eureka to Nephi, via Mona, Beaver to Frisco, via Milford, Ogden to Syracuse, via Hooper, Rawlins, Wyo., to Colorado State line, via Dickerson, Cheyenne to Douglas, Logan to Cache Junction, via Mendon and various branch lines.

"In the year 1902 we propose first to build a line to the newly discovered gold fields in the Thunder Mountain district in central Idaho; next to finish our line from Haily, Idaho, to the junction of the north and south line at Blackfoot, Idaho, then to continue the line from Douglas, Wyo., through Casper to Lander, and to a junction of our Montana system at Red Lodge, Mont., and extend our east and west line in Montana from Billings, our present terminus, to Miles City. With the building of the exchange at Cheyenne, Wyo., we propose to cover the whole State of Wyoming, within the next two years with a series of long-distance lines that will place the remotest corner of Wyoming in perfect touch with the capital.

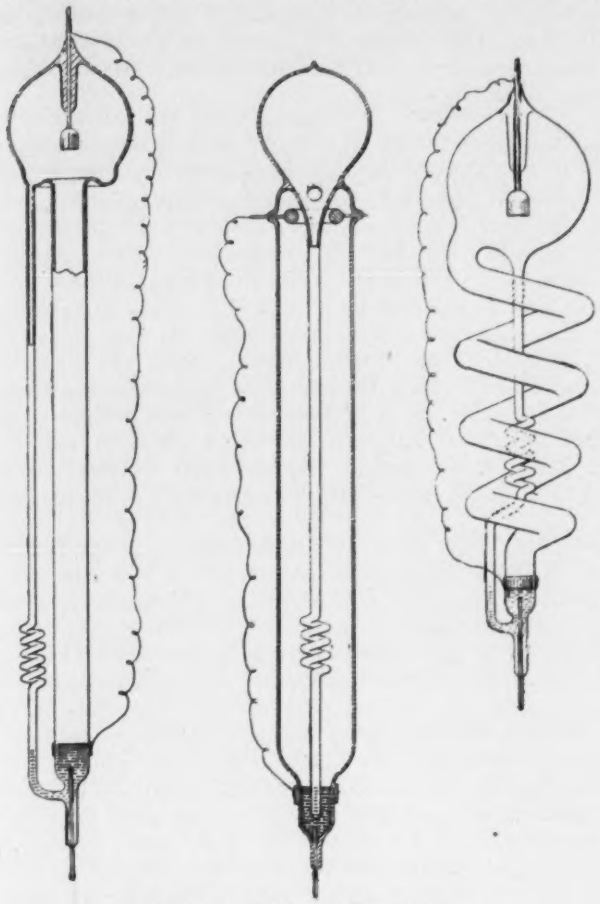
"Our manager, Mr. D. S. Murray, is at present in Boston, and is expected home about Dec. 10. This trip was made with the intention of visiting the larger cities of the East which have recently installed the latest improvements in switchboards and other telephonic equipment. Upon his return it is expected he will have a number of suggestions to offer that will add to the proficiency of the local service."

Buenos Ayres Lighting and Power Statistics.

The report of public lighting of the city of Buenos Ayres during the year 1900 shows the following statistics: Number of kerosine lamps, 8590, consuming 795,200 liters of oil, at a total cost of $220,550; number of gas lamps, 14,084, consuming 6,165,550 cubic meters of gas, at a total cost of $1,024,181; electric lights, 380 incandescent and 1335 arc lamps, at a cost of $8,459 per month. In the private service of the three gas companies the length of mains was 8636 squares. The number of cubic meters consumed was 26,573,502. The four electric light companies had a total of 5704 subscribers, to whom were furnished 135,359 incandescent and 1418 arc lamps. The cost per kilowatt, gold, averaged $0.201 for light and $0.103 for power. The output in kilowatts of the four companies furnishing electric light and power shows the following aggregates: Light, 5,510,372; power, 704,881; traction, 2,862,859; total, 9,078,112.

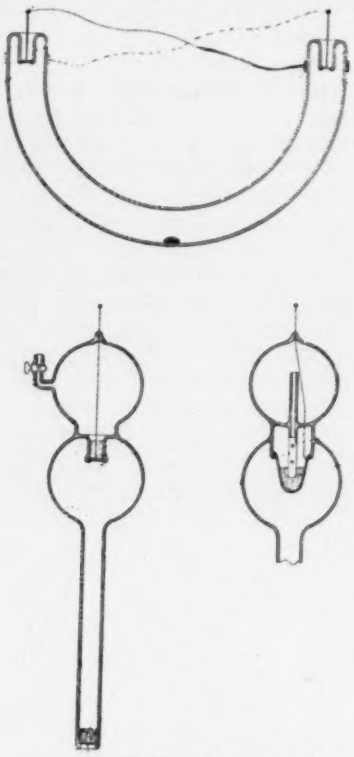
New Forms of Vapor Lamps.

Several new forms of vapor lamps are the subjects of patents issued Dec. 3 to Peter Cooper Hewitt. It will be recalled that the principal features of the Cooper-Hewitt vapor lamp are the use of



FIGS. 1, 2 AND 3.—VAPOR LAMPS.

sulphide of mercury to assist starting; a definite relation with respect to the resistance of the vapor or gas path and the heat radiating surface of the tube, and an electrical connection between the upper



FIGS. 4, 5 AND 6.—TERMINALS FOR VAPOR LAMPS.

electrode and a conducting surface, such as tinfoil on the exterior of the tube surrounding the mercury of the lower electrode. By properly proportioning the cross-section and length of the tube, some of the mercury is cooled and returned to the bottom of the tube, thereby controlling the density of the vapor and rendering the lamp self-regulating.

The accompanying Figs. 1, 2 and 3 show three forms of the lamps in which the condensed mercury is returned to the lower end of the tube through a special return tube. In Fig. 1 this tube is exterior to the vacuum tube, and one part has a spiral form to provide for contraction and expansion. In Fig. 2 the return tube is inside the vacuum tube, and in Fig. 3 the vacuum tube has the form of a spiral and surrounds the return tube.

Another patent relates to terminals for vapor lamps, three forms of which are illustrated in Figs. 4, 5 and 6. In Fig. 4 the terminal consists of a corrugated platinum disk for each electrode. The lamp illustrated, to which these terminals are applied, is in itself a new form, the mercury being represented by a small globule; when the lamp is in operation more or less of this mercury is volatilized to afford the requisite density of vapor. In order to dissipate the heat generated at the electrode, a cooling chamber may be supplied, as in Figs. 5 and 6. In Fig. 5 it will be seen that there is a cup-like cavity to contain some cooling fluid, as water or mercury, and above the same is a cooling chamber for condensing the vapor generated from the liquid. In Fig. 6 the electrode has also a cup form and the cooling chamber communicates to the electrode chamber through holes, as indicated. A tube extends from a point near the bottom of the electrode chamber to a point in the cooling chamber, and suitable openings are provided so that the emitted fluid may enter the tube and passing upward escape to the top, thus causing a continuous circulation. Another form of terminal employs a re-entering cavity in the top of the tube, which is packed with wires, the heat from the electrode being conducted to the upper ends of the wires and dissipated into the air.

Another patent granted the same date relates to automatic means whereby upon starting, a Wehnelt interrupter gives a high voltage, the interrupter being automatically cut out of circuit when the tube approaches its normal lighting condition.

CURRENT NEWS AND NOTES.

ELECTRIC AUTOMOBILE CABS have given a good example of their ability during the recent slippery weather, when horses were down in every direction, all over New York City, while the automobiles skated around with the utmost indifference and perfect success. The horse was often helpless and more than ever a nuisance.

FRENCH TELEPHONE RATES.—A cable dispatch from Paris of Nov. 30 says: The Minister of Posts and Telegraphs, M. Millerand, announces a general reduction in the price of telephone service throughout France. In Paris the rates are reduced from $80 to $60 a year from January. Another reform is the reducing of the charge for pneumatic-transmitted messages—the "petit bleu"—from 10 to 6 cents.

CAUSTIC SODA FROM FUSED ELECTROLYTES.—The issue of ELECTRICAL WORLD AND ENGINEER for June 1 of the current year described and illustrated the Acker process for the production of anhydrous caustic soda by electrolysis of molten sodium chloride with a cathode of lead. Acker's improvement over prior methods consists in effecting a rapid circulation of the fused lead, and particularly in accomplishing this by injecting steam directly into the metal, for, thereby, not only is the lead amalgam transferred from the field of decomposition, but the contained sodium is oxidized to the hydrate. Thus the steam is called upon to perform two functions, and, as is always the case under such circumstances, the question arises whether the two effects are proportionate, whether an amount of steam just sufficient to yield anhydrous caustic is capable of circulating the lead at the rate which corresponds to take the maximum current efficiency of the cell. Since the two factors are not mutually dependent, it is probable that this desirable relation does not exist, but that enough steam to properly fulfill the mechanical part will be in excess of that required for the chemical reaction, the result being a diluted caustic. That this is in fact the case would seem to be indicated by the latest patent, issued to Acker Dec. 3. The new cell differs from that previously figured in one respect only, the steam is no longer solely depended on for the circulation, but the lead is kept in motion by a bladed propeller immersed therein at the bottom of the injection well.

PACIFIC CABLE.—The Seattle Chamber of Commerce has adopted resolutions addressed to Congress urging very warmly an American cable from Puget Sound to Alaska, the Philippines and Asia.

TESTING SUBMARINES.—The electric submarine boat "Fulton" has been tested again at Peconic Bay for the benefit of Commodore V. Geelmuyden, of the Norwegian Navy. While submerged at a depth of 10 ft. and traveling rapidly, she fired a dummy regulation Whitehead torpedo and struck a given mark.

ANNOYING TELEGRAPH EXECUTIVES.—An operator named Lambdin has been arrested in New York City on the charge of sending anarchistic letters of a threatening nature to Mr. George J. Gould and other officials of the Western Union Telegraph Company. In the letters received, all typewritten, a defective "s" appeared. This erratic discharged operator had a machine that lisped.

THE KAISER'S TROLLEY PLANS.—A cable dispatch from Berlin of Nov. 21 says: The committee of the municipality appointed to deal with the Unter den Linden controversy between the Emperor and the municipality has capitulated, and to-day adopted, by a vote of 9 to 2, the Emperor's plan for the projected alterations, which are to have the proposed electric connecting road across Unter den Linden pass underneath that thoroughfare. The municipality planned to have the electric road pass over it.

PAN-AMERICAN DIPLOMAS.—The Buffalo Pan-American Exposition Company is so deeply embarrassed financially that it is unable even to provide diplomas for exhibitors who won them. This announcement was made yesterday, when it was stated that diplomas costing 82 cents each would be too expensive, and that the best the company could do would be to furnish two kinds of diplomas, one costing 33 cents and another costing 25 cents. About 10,000 in all are to be issued, and the total expense will be $3,000, which the company is unable to meet.

DIRIGIBLE TORPEDOES.—It is stated from London that Commander Richardson Clover, the Naval Attache who has just sailed, takes back for the inspection of the Navy Department yet another invention for controlling torpedoes by wireless telegraphy. The inventor's experiments are claimed to have shown that torpedoes not only can be steered by etheric waves, but can be stopped, started and fired at will by means of this agency. There is, however, nothing new about such an idea. It was proposed, among others, by Captain G. O. Squier, United States Signal Corps, about 1897-8, before the Spanish-American war, and later on Mr. Tesla took out some patents on the subject and showed a working model.

PACIFIC CABLE.—Mr. John W. Mackay said recently, while in Los Angeles, with regard to the Commercial Pacific Cable Company's plans: "We have already chosen San Francisco for the Pacific cable terminal. The work of laying the first section of the cable, from California to Honolulu, will be started as soon as the cable can be furnished and shipped to the two starting points of the section. This ought to take about 75 days, and telegraphic communications with Hawaii may confidently be looked for by early fall." Mr. Mackay added that the United States Government would have no proprietary interest in the trans-Pacific cable. In the times of war the cable would be turned over for Government purposes.

A. S. M. E. OFFICERS.—The following are the new officers of the American Society of Mechanical Engineers, elected in New York City, on Dec. 4: President, Edwin Reynolds, V.-P. Allis-Chalmers Company, Milwaukee, Wis.; treasurer, W. H. Wiley, John Wiley & Sons, New York; vice-presidents, Wilfred Lewis, president Tabor Manufacturing Company, Philadelphia, Pa.; M. E. Cooley, professor mechanical enigneering, University of Michigan; M. P. Higgins, president Norton Emery Wheel Company, Worcester, Mass.; managers, R. S. Moore, superintendent Risdon Iron Works, San Francisco, Calif.; H. A. Gilliss, superintendent Richmond Locomotive Works, Richmond, Va.; Charles H. Corbett, V.-P. Continental Iron Works, Brooklyn, N. Y.

BEAUTIES OF GOVERNMENT TELEPHONY.—One morning last week the people of Caracas, Venezuela, who use the telephone, were very much surprised and alarmed at receiving no reply to their repeated calls on "Central." Any unexpected occurrence, in these troublous times of revolution, is sufficient to cause alarm. An investigation resulted in showing that the Government had got wind of a revolutionary plot, and had taken possession of the central telephone office and stopped the service, in order to prevent easy communication between the conspirators and in order to use the system exclusively for its own purpose of effecting the arrest of the suspected conspirators, their friends and relatives without loss of time. This was done.

GOVERNMENT TELEGRAPHY on the European plan is often urged in this country. A special dispatch from London of Dec. 7 says: Here is an instance of intelligent telegraphic service as it is conducted under government supervision in rural England. A telegram was sent from Dunwich to Wessleton, Suffolk, villages about two miles apart. It took one and one-half hours in transit. Inquiry showed that it was first telephoned from Dunwich to Southwold, four miles as the crow flies, then telegraphed from there to Lowestoft, 11 miles. Then from Lowestoft, which lies in the extreme north of Suffolk, it was telegraphed to Ipswich, in the south a distance in a straight line of 38 miles. From there it was retransmitted another 18 miles to Saxmundham, then a few miles more to Dursham, whence it was sent by foot messenger to Wessleton. A boy could have walked the distance in about a third of the time.

INCREASE OF NICKEL TELEPHONES IN CHICAGO.—As noted in these columns something over a year ago, the nickel-in-the-slot telephone was first introduced in Chicago. The demand for this class of instruments is enormous, as it fills a place hitherto unprovided for in the telephone service of that city. Two classes of nickel-in-the-slot machines are used—one on a two-party and the other 10-party line service. The rate at which these instruments are put in is limited only by the rapidity with which they can be turned out from the factory and the necessary wires run and provisions made on the exchange switchboard; in fact, the company is overwhelmed with new business and is even going to the extent of letting out different portions of its work of placing instruments, running wires and building pole lines to various contractors. The number of five-cent telephones put in since this service was started about a year ago is in the neighborhood of 7000, which means an enormous additional load on the company's exchanges.

NEW YORK ELECTRICAL SOCIETY.—At the 218th meeting, Nov. 26, 1901, the following new members were elected: Walter A. Houghtaling, 15 Dey Street, Room 404, New York; Leonard T. Horner, Crocker-Wheeler Company, Ampere, N. J.; E. J. Wehrley, 15 Dey Street, Room 404, New York; T. P. McCray, 101 Main Street, Fairmont, Va.; J. Roberts Wilson, Crocker-Wheeler Company, Ampere, N. J.; Lyman P. Hammond, 39 Cortlandt Street, New York; F. S. Blackall, 39 Cortlandt Street, New York; H. W. Olin, 330 Lenox Avenue, New York; G. A. Callahen, Westinghouse Electric & Manufacturing Company, 120 Broadway, New York; W. L. Conwell, 120 Broadway, care Westinghouse Electric & Manufacturing Company, New York; Frank Clark Cosby, 120 Broadway, New York; W. S. Rugg, 120 Broadway, New York; George Wacker, 3638 Park Avenue, New York; Charles E. Monroe, 296 Broadway, New York; Lloyd Reed, 54 Hicks Street, Brooklyn, New York; Frank Mauro, 37 Stanton Street, New York; A. T. Jenks, General Electric Company, 44 Broad Street, New York.

STEAM AND TROLLEY.—The Pennsylvania Railroad Company has given formal notice that steam trains will be substituted for the trolley service between Mount Holly and Burlington, N. J., which was interrupted by the burning of the power house at the former place several weeks ago. The Pennsylvania Railroad officials selected the short line between Mount Holly and Burlington for the experiment with electricity. With the aid of the Westinghouse Electric Company, which was greatly interested in the project, a thoroughly up-to-date power plant was installed at Mount Holly, and large modern electric cars provided. The line was opened on June 18, 1895. The operation of the system was closely observed by the officials of the company, and while they refrained from public utterances on the matter, it became known, after the line had been in operation for some time, that it did not meet their expectations, and that there would be no extension of the electric system. The line has been most curiously mismanaged—some people say intentionally—since the change to electricity was made.

THE NERNST LAMP is to be used in Unionville and Farmington, Conn. A number have already been installed in the latter place for street lighting.

NEW TESLA PLANT.—That work is going on actively at Mr. Tesla's new laboratory and factory at Wardenclyffe, Long Island, is shown by the fact that two men were badly hurt there last Saturday while blasting with powder for a foundation.

LECTURE ON POLARIZED LIGHT.—A meeting of the New York Electrical Society will be held at the College of the City of New York, Twenty-third Street and Lexington Avenue, at 8 o'clock on Thursday evening, Dec. 19. Professor Dayton C. Miller, of the Case School of Applied Science, Cleveland, Ohio, will lecture on Polarized Light. This will be one of the most important lectures of the season, and members are requested to be on hand early. Ladies will be welcome.

A MEMORIAL TO FULTON was unveiled in Trinity Churchyard, at the head of Wall Street, last week by the American Society of Mechanical Engineers, then holding their annual meeting. Preliminary exercises were held in the adjoining Real Estate Exchange when Rear Admiral Melville and Dr. R. H. Thurston delivered addresses appropriate to the occasion, describing and eulogizing Fulton's work. A short service then followed in Trinity Church, conducted by Dr. Morgan Dix, at which the Rev. R. F. Crary, of Poughkeepsie, a grandson of Fulton, spoke in behalf of the family of the great inventor of the steamboat. The monument is of granite, bearing on its face a bronze medallion of Fulton in high relief, made from designs by J. W. Gosling and Albert Wennart, after an oil painting of Fulton made by himself and now in the possession of the society.

NEW YORK CENTRAL.—According to report, officials of the New York Central Railroad have considered plans relative to the feasibility of running through trains from the Battery over the elevated railroad and then via the Putnam Division of the New York Central to Yonkers and other suburban points. President Newman, speaking of the possibility of such an arrangement, said: "We would have no objection to the running of through trains by electricity in connection with the Manhattan elevated. Such a plan would be entirely feasible. But in order to make such an arrangement we don't intend to purchase any Manhattan stock. It would not be necessary, as such an object could be accomplished by a traffic agreement." He added that at the present time there was no such agreement under consideration. Manhattan Elevated stock has been optimistically active on these rumors.

ELECTRIC DENTAL FURNACE.—A patent issued Dec. 3 to Dr. John F. Hammond, of New York, represents the latest construction in a highly developed art. The device is a furnace for dental work and is based on familiar principles, the heat being electrically developed in a platinum resistance wire embedded in the inner surface of a fire clay muffle. Successive concentric layers, respectively of loose sand, baked fire clay and metal surround the muffle and act as heat retainers, while the front is closed by a mica door for convenience in observation. The whole is mounted upon upright front and rear standards, carried by a base provided with suitable contacts, a rheostat and other accessories. The furnace carries several minor improvements in construction, all of which are directed to facilitating the interchange and repair of parts, the most important of these relates to the construction of the heating wire, which is provided at short intervals with loops extending outwardly through the muffle walls, whereby expansion and contraction are allowed for and any break in the circuit is readily located and bridged.

CHICAGO ELECTRICAL ASSOCIATION ELECTION.—The election of officers for the Chicago Electrical Association, held Dec. 6, 1901, resulted as follows: Professor P. B. Woodworth, president; C. Wiler, vice-president; H. G. Dimick, treasurer; W. B. Hale, secretary and librarian; A. M. Blumenthal, auditor; R. F. Schuchardt, J. G. Wray and C. H. Roth, directors. At the same meeting Mr. Van Rensselaer Lansingh delivered a lecture on recent advances in illumination. He took up especially the matter of diffusion of light so as to produce an even illumination without glare or shadows, as accomplished by holophane and other globes. The lecture was illustrated with practical demonstrations in which the advantages of scientifically constructed globes for diffusing and directing light were very forcibly and clearly demonstrated. The most striking point in the lecture, however, was when Mr. Lansingh had his audience critically trying to decide whether there was any difference in the illumination of a given surface by a globe covered and an uncovered light, both lights supposedly being of the same candle-power. Some of the more critical thought the uncovered light illuminated the surface below it a little the best, but admitted that there was not much difference and that the quality of the illumination was better under the globe covered light. When it was then suddenly revealed that the globe-covered lamp was of only half the candle-power of the uncovered light, and that the audience had been comparing a 16-cp uncovered light with an 8-cp globe-covered light, the hit made can be imagined.

AMERICAN ELECTRO-CHEMICAL SOCIETY.—A movement was recently initiated, having for its object the founding of a national electro-chemical society to be modeled on the same general plan as the American Institute of Electrical Engineers. The products of electro-chemical industries in this country at the present time amount to about $100,000,000 per year. The growing importance of these industries and the fact that scientists and engineers interested in electro-chemistry are now distributed among at least half a dozen different societies, and heretofore have had no common medium of communication, are considerations which are believed to fully justify the movement. As noted at the time in our columns, a preliminary meeting in the interest of such an organization was held Nov. 1 at the Engineers' Club, of Philadelphia, Prof. J. W. Richards, vice-president of the American Chemical Society, acting as chairman and Mr. Carl Hering, past president of the American Institute of Electrical Engineers, as secretary. All those present were heartily in favor of forming such a society, and numerous encouraging letters were received from all parts of the country, those from representatives of the electro-chemical industries being especially favorable. It was unanimously decided that such a society should be founded as soon as a sufficient number of members could be secured to insure success. Committees were appointed to secure members and to arrange for a meeting in the near future, at which the society will be formally organized. It was the opinion of those present at the preliminary meeting that the annual dues for membership should not exceed $5, and that there should be only one class of members. Those who desire to become members of the society may send in their adhesion to Dr. Charles A. Doremus, 17 Lexington Avenue, New York City, chairman of the committee on membership.

LETTERS TO THE EDITORS.

Superposed Alternating and Direct-Current Transmission.

To the Editors of Electrical World and Engineer:

Sirs.—I have read with much interest your description of a recent patent granted to Dr. Bedell relating to a saving of 50 per cent of copper that can be effected by causing both direct and alternating currents to traverse the same wire, and I remark what you say as to the discovery of a principle.

If my memory serves me correctly, this is simply a rediscovery. The fact was recorded by English electricians some six or eight years ago, that several various currents when traversing the same wire showed something less than the sum of their various amperes in that wire. I saw this stated in the technical papers at the time. The principle is a beautiful one, and a useful application of it would be very interesting.

NIAGARA FALLS, N. Y. WILLIAM SMITH HORRY.

High Speeds.

To the Editors of Electrical World and Engineer:

Sirs.—In an editorial in your issue of Nov. 23 on the Zossen high-speed traction experiments, it is stated that a speed of a mile in 30 seconds would have to be made before the record leaves us. Has it occurred to you that ice yachts on the Hudson every winter exceed railroad speeds? If not mistaken, I think the record mile is 26 or 27 seconds, and established by a girl from Albany on a steel frame yacht built specially for record purposes. I think this speed record was made some two or three winters ago. This is probably faster than any other human has ever traveled—willingly at least. I have made more than 90 miles per hour myself on the St. Lawrence River in

a home-made affair. There is also the record made by old "999" of World's Fair fame, with her record between Albany and Syracuse on a stormy night of 112½ miles per hour, a speed which was maintained for over 3 miles with a regular train.

Mansfield, Ohio. A. B. Brown.

Mileage of Ocean Cables.

To the Editors of Electrical World and Engineer:

Sirs.—In your issue of Nov. 23 you must have misquoted so great an authority as Mr. G. G. Ward when you make him say that the Silvertown Company has laid most of the deep-ocean cables throughout the world. In the 1894 issue of the Telegraph Construction & Maintenance Company's map it distinctly shows that out of a total of 175,000 knots they have laid 125,000. A copy of this map can be seen in the superintendent's office of the Anglo-American Telegraph Company, 8 Broad Street, New York. Since then the St. Helena-Cape Town-Australia cable has been laid, and many others. I think the Silvertown Company must be conceded to play at least second fiddle.

Wilkesbarre, Pa. E. W. Stevenson.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers

Heyland Induction Motor.—Heyland.—A brief communication to the editor of *L'Eclairage Electrique*, the translation of which is as follows: "I take pleasure in adding to the note which I sent you, that the first tests have completely confirmed the theory which was questioned. I have just seen running, on Nov. 18, in the workshops of the United Electric Company, of Vienna, a 12-hp non-synchronous motor, which had been modified according to the indications of my article of Aug. 8, published in the *Elektrotechnische Zeitschrift*. The phase difference between current and e. m. f. was completely annulled, and the magnetizing current reduced from 15 to 3 amperes. Disconnected from the supply mains and connected to transmission mains, the motor ran as generator. It excited itself, exactly like a direct-current shunt dynamo, and was capable of lighting a certain number of incandescent lamps. The results shall be published shortly."—*L'Eclairage Electrique*, Nov. 30.

Properties of Collector Rings.—Latour.—An article in which he replies to the criticism of Leblanc and Bunet (Digest, Nov. 23). It appears that he had anticipated Heyland in the fundamental idea concerning the properties of collector rings, upon which the new Heyland motor is based. On March 15, 1901, he received a French patent for a self-exciting alternator. He has had experiments made by Boucherot regarding the fundamental question, and reproduces his report. "The experiments were made with the armature of a small direct-current dynamo with four poles. There were 24 nearly closed slots, 48 drum-wound coils, the diametrically opposite coils being connected in series, and the groups of two, thus formed, were connected to 24 segments of a commutator, which had 48 segments; the other 24 segments were connected to the first by a connector; four carbon brushes were placed at 45 degs. from one another on the commutator. The armature was placed in a laminated stator, identical with that of an induction motor, with eight nearly closed slots, and open circuit windings, well insulated from one another, so that no current could flow through them. The air-gap was about a millimeter. The measurement of the resistance between the brushes for direct current gave about 1.8 ohm, just as well between the first and third brushes, as between the second and fourth brushes. The brushes were then connected to a source of two-phase currents, for which a direct-current dynamo with four slip rings was used. The problem to be found out by the experiments was not to determine the conditions under which the commutation takes place, but only to determine the variation of the impedance. A first experiment with a frequency of about 25 showed that the impedance varied from about 15 ohms at rest and about 2 ohms in the neighborhood of synchronism and increased after that. A second experiment with a higher frequency, 35, showed that the impedance at rest was about 25 ohms and about 2 ohms near synchronism, for the proper direction of rotation; for the opposite direction the impedance increased constantly up to about 50 ohms for a speed equal to that of synchronism. It was also found that the impedance does not vary, whatever the direction of rotation, for single-phase alternating currents." The author gives a detailed mathematical theory and points out that the sparkless commutation is also an indispensable requirement of practice. He shows that good commutation is possible only at synchronism. Synchronism, which corresponds to the case that the reactance of the ring is zero, gives good commutation. The expression of the reactance and of the sparks are two allied phenomena. He quotes the following from his patent. He supposes a commutator provided on the stator of a polyphase induction motor. He considers the special case of three-phase currents with Gramme winding and delta connection; the three-phase currents are supplied by three brushes placed at 120 degs. between one another. When the brushes are fixed, there is an ordinary rotating field, revolving with a speed S, in synchronism with the frequency. But when the three brushes are revolved together in the opposite direction with a speed s, the revolving field becomes fixed in space. Instead of revolving the brushes, he has them fixed and revolves the stator. This principle enables him to devise a self-exciting alternator. This alternator consists of an armature stator, and a primary rotor. He has indicated in his patent that these alternators would have the property common with synchronous motors, in producing magnetizing currents when the motor is overexcited.—*L'Eclairage Elec.*, Nov. 23.

Eddy Current Loss in Dynamos.—Picou.—A mathematical article on the eddy currents in the pole pieces of direct-current machines. The hypothesis that the resistance of the eddy currents can be neglected, compared with the self-induction, seems probable at the first glance, on account of the large mass of the pole pieces which offers a broad path to the eddy currents; but the high frequency has the effect of localizing them in a rather thin layer near the surface, so that the resistance may be quite large. The conclusion that the power lost by eddy currents varies as the square of the speed, would be correct only when there is no phase difference; but if the phase difference is very great, the power is more directly proportional to the speed.—*L'Ind. Elec.*, Nov. 10.

REFERENCE.

Synchronous Converter.—Rushmore.—The first part of an illustrated article on "The design and action of the rotary converter." He discusses the general principles of its construction, the influence of frequency, and ratio between the direct and alternating-current e. m. f.'s.—*Eng. Mag.*, Dec.

Power.

Electrically-Driven Printing Press.—An illustrated description of the Hoe printing press, used at the Glasgow exhibition for printing special issues of a newspaper. It is a four-roll web-printing machine and folder, and prints the newspaper in 4, 6 or 8 pages at a speed of 48,000 per hour, and in 20, 24 28, or 32 pages at a speed of 12,000 per hour, delivering the sheets folded to half paper size. The electric motor gives 50 hp when running at the normal speed of 400 revolutions, taking current at 500 volts. It develops 100 hp at starting. When "making ready," the speed of the motor has to be reduced to a crawl of about 20 to 30 r. p. m., and to effect this a reduced voltage is necessary, which is accomplished by means of a rotary transformer. A flexible steel coupling connects the motor shaft and the first motion shaft of the printing press. The rim of the coupling acts as the drum of the electromagnetic brake. The solenoid of the electromagnetic brake is in series with the 50-hp motor, and can thus be brought into action at any moment to stop the printing press. Push-buttons are arranged all around the press, so that should any accident happen it is only necessary to press the nearest push button; this throws out the main circuit breaker

on the controller and the electromagnetic brake at once comes into action.—Lond. *Elec.*, Nov. 22.

Electric Power in a Manufacturing Plant.—An illustrated description of the power plant of the Silvertown india-rubber works. The new power station contains four direct-current dynamos, each giving 1500 amperes at 210 volts. The number of motors at present installed is 83, ranging from small motors of 1 hp up to motors of 150 hp. There are 50 arc lamps and the equivalent of 14,000 incandescent lamps of 8 cp.—Lond. *Elec. Rev.*, Nov. 15.

REFERENCE.

Steam Engine.—An illustrated description of a new three-cylinder compound engine of Allen, Son & Co.—Lond. *Elec.*, Nov. 22.

TRACTION.

High-Speed Railways.—A note giving the following official information on the experiments made by the "Studiengesellschaft" on the trial road at Zossen. The experiments at the beginning of September. The experiment with the two motor cars were first made with the aid of a locomotive, in order to get the two wagons into good running condition. After these preliminary runs the experiments with electric traction were begun, starting with a speed of 60 km. per hour; this speed was gradually increased to 100, 120, 140 km., and reached the maximum of 160 km. per hour (96 miles per hour), at a voltage of more than 10,000 in the supply circuit. On European railways the maximum speed is said to be 130 km., and on American railways the highest speed obtained is said to be 140 km. per hour. The experiments are said to have been successful, and important results have been obtained regarding the starting speed and the braking at maximum speed, also regarding the visibility of the signals, the consumption of power, the air resistance, etc. The total electrical equipment of the cars, the conductors, and the contact devices for taking off the current, have proved extremely satisfactory, so that in this respect it is doubtless that still higher speeds may be obtained. But the track is not considered to be safe enough, so that before the experiments are to be continued, the track and roadbed will be strengthened in the interest of safety.—*Elek. Zeit.*, Nov. 21.

Alternating vs. Direct-Current for London Underground Railway.—A full account of the proceedings at the Underground Railway electrical inquiry at London, Lyttleton being the arbitrator appointed by the Board of Trade to decide what system of electric traction should be applied to the Metropolitan Railway and the Metropolitan District Railway. The latter favors the direct current system of the Thomson-Houston Company, the former the alternating-current system of Ganz & Co. Expert witnesses on the direct-current side were E. W. Rice, of the Gen. Elec. Co., of this country; J. Swinburne, T. R. Chapman, of Chicago, and P. Dawson. On the alternating-current side were O. T. Blathy and Kando, of Ganz & Co.; G. Kapp, Ewing, Cardew and S. P. Thompson. Counsel for the direct and alternating-current sides were Moulton and Cripps, respectively. The inquiry has been closed, but no decision has yet been given.—Lond. *Elec., Elec. Rev.*, Nov. 1, 8, 15, 22.

Long-Distance Electric Railroads.—HOSPITALIER.—An article in which he discusses briefly the problems involved in the introduction of electric service on long-distance railroads. He endeavors to show that the use of single-phase alternating current is not as impossible or impractical as it might seem at first glance. It would be the most simple and economical system. To overcome the difficulty of starting, he recommends having a single-phase induction motor ordinarily running loose at a speed near synchronism; for starting, this motor is connected to the wheels mechanically by means of a cone coupling.—*L'Ind. Elec.*, Nov. 10.

Long Runs of Electric Automobiles on one Charge.—JOEL.—The limit distance of the run of an electric automobile on one charge is a test of the merits of the carriage as a whole. The construction of the carriage to bear the weight of the batteries and useful loads, the distribution of those weights over the wheels, the diameter of the wheels and method of gearing are all of importance. The earlier electric carriages of Rackenzaun and others were limited to from 20 to 30 miles' run on one charge, and the percentage of weight of the battery to the total weight was only about 20 to 25 per cent. The percentage in recent electric carriages is from 40 to 50 per cent, and that is one reason why the limit run now possible is increased from 20 miles to 100 miles. The latest record run is 190.3 miles on one charge, the battery being 50 per cent of the total weight. The unit now accepted as a measure of efficiency is "watt-hours per ton mile." He gives data for six long-distance runs on one charge; the total miles were 100, 162.5, 53, 94.8, 187.5, 190.3, the watt-hours per ton mile 130, 130, 140, 138, 78, 115, respectively. He has analyzed different proportions, costs and useful ton-mileage of many types of electric automobiles, and as a result, has found that cars made with proportions of 33.3 per cent weight of car and motor, 33.3 per cent weight of batteries, and 33.3 per cent passengers or load, best fulfill all the economic conditions. Such proportions are adopted to the construction of any type of electric automobile. The cost per ton-mile of useful or paying load, passengers or goods, for electric current in such cars comes out at 2 cents per ton-mile at a charge of 6 cents per unit for electric current and 0.15 cent per mile for each passenger. This compares favorably with the cost of petroleum or steam motor cars, and in considerably less than the cost of horse-drawn vehicles.—Lond. *Elec. Rev.*, Nov. 22.

Electric Automobile.—Some notes on a Krieger automobile which took part in a recent run of the London Automobile Club. The weight of the car in running order is 3700 lbs., and it carried 5 passengers. The total time distance was 90.5 miles, the total time 6 hours and 26 minutes, and the average speed 14 miles an hour. A charge of 30 units was put into the cells before starting and 6 units at a stop on the way.—Lond. *Eng'ing*, Nov. 22.

WIRES, WIRING AND CONDUITS.

High-Tension Cables.—SCHAEFER.—An article with several tables, giving the results of tests made at the cable works at Duisburg, Germany. Cables with fibrous insulation require some sort of protection against the entrance of moisture at exposed ends, and this protection cannot, under all circumstances and in all positions, be satisfactorily applied or kept in efficient order. To avoid any trouble with such end protections, he has for many years used vulcanized india-rubber insulated, lead-cased and armored cables for house-connections, feeding points of electric tramways, and, in fact, in all cases where ends of cables had to be exposed. The joint between fibrous and rubber cables was generally made in a box, placed underground. India-rubber insulated cables being, however, very expensive, he decided after numerous experiments to use in their place cables insulated with "kabelit," a material which is mainly composed by hydrocarbons, does not necessitate the use of tinned conductors, and is considerably cheaper than vulcanized india-rubber. Kabelit-insulated cables have since been extensively used for low-tension work and have answered uniformly well. He determined the break-down pressures for six sizes of kabelit cables, each of five meters' length and varying in the cross-section of the conductor from 16 to 150 mm., and in the thickness of insulation from 1.45 to 2.5; the break-down voltage of the six samples was 18,000, 19,000, 21,000, 16,000, 20,000, 23,000 volts, respectively; the time during which the breakdown voltage was applied was 18, 20, 3, 8, 6, 8 minutes. The results fit pretty well in Baur's formula, recently noticed in the Digest. As kabelit is somewhat softer and more yielding than the insulating materials which have hitherto been used, he endeavored to render it stiffer and less yielding. He tried an insulation of alternate layers of kabelit and vulcanized india-rubber, paper and other materials which can be applied in thin layers. He gives the results of several tests made with such cables. It appears that cables insulated with alternate layers of kabelit and paper, stand a higher pressure than cables insulated with kabelit alone. He finally refers to experiments made since September, 1898, with two lengths of cables at the Etsch Works, Meran, in the Austrian Alps, in order to find out experimentally whether underground cables can be used in connection with bare overhead conductors, without great danger of being damaged by atmospheric discharges. The first cable contains three cores, each composed of a strand of 19 tinned copper wires, each 1.53 mm. in diameter, insulated with vulcanized india-rubber—no pure rubber next the conductor—of a thickness of 4.25 mm., taped and drawn through colored wax. The three cores are stranded together, wormed and served with ozokerite-impregnated jute yarn, cased in lead and armored with steel hooping. The second cable contains three cores, each composed of a strand of 19 copper wires, each 1.53 mm. in diameter, insulated with kabelit of a thickness of 4.25 mm., taped, ozokerited, and cased in lead; the three lead-cased cores are stranded together, wormed and served with tarred jute yarn, between layers of asphalt compound and armored with steel hooping. The cables were laid underground and connected

to an overhead circuit of bare copper wires, leading from Meran to Bozen and having a length of about 25 miles. The load was about 25 amperes at 11,000 volts, and varied from this amount to no load in either, and in all three phases. As the experiments were meant to last for about 12 months, no special arrangements were made to protect the cable ends against surface leakage. The cable ends were fully exposed to all atmospheric influences. After more than two years' exposure to all kinds of weather, the cable with vulcanized india-rubber insulation burned through at the spot where the three cores separate, which was doubtless caused by surface leakage from the badly protected ends. After cutting off the damaged end, about half a yard, the cable itself was found to be in a perfect condition. The kabelit insulated cable has never been injured yet, although severe atmospheric discharges have passed through both cables and have done considerable damage in the station.—Lond. *Elec.*, Nov. 22.

Electro-Physics and Magnetism.

Pressure Exercised by Light.—Lebedew.—He has succeeded in demonstrating both qualitatively and quantitatively, the pressure exercised by light, which is postulated by Maxwell's theory. The obstacles hitherto met with were the radiometer action, which is thousands of times stronger than the action sought for, and the disturbing effect of convection. He eliminated the latter by reversing the illumination repeatedly, and the former by high exhaustion, a large bulb, and the exclusion of rays capable of heating the walls of the bulb. To facilitate a rapid equalization of heat in the radiometer vanes, he made them of very thin aluminum foil, suspended torsionally by a glass thread arranged as in the Cardani suspension. The light used was that of an arc lamp, and its incident energy was determined calorimetrically. The surfaces of the radiometer vanes which were either plain or blackened, were tested with regard to their reflecting powers. The absolute error of the aggregate measurements was 20 per cent. The result agrees with the theoretical values of Maxwell and Bartoli within 10 per cent. The pressure is directly proportional to the energy of the incident light, and independent of its color.—*Ann. der Physik*, No. 11; abstracted in Lond. *Elec.*, Nov. 22.

Electron Theory of Light.—Voigt.—An attempt to formulate an electron theory of the changes in the optical properties of ponderable bodies produced by mechanical and thermal deformation. The electron theory assumes the existence within ponderable bodies, of corpuscles oscillating about approximately fixed positions. But both the quasi-elastic force which drives the particle back to its mean position and the resistance it experiences in its vibrations or revolutions, hitherto lacked electrodynamic explanation. He shows, however, that the quasi-elastic forces decrease when a liquid undergoes compression, so that the stability of oscillatory electrons is lessened. A rise of temperature under constant pressure leads, on the other hand, to an increase of the quasi-elastic force and of the stability. In solids the exact reverse is the case. He explains how in gases and liquids, compression produces a displacement of the spectrum lines towards the red, owing to the decrease of the quasi-elastic forces, and investigates in detail the effect produced by adding the same solution to different solvents.—*Ann. der Physik*, No. 11; abstracted in Lond. *Elec.*, Nov. 22.

Ionic Velocities in Gases.—Von Wesendonck.—The ratio of the velocities of negative and positive ions in point discharges through gases, has been put at values ranging from 1.32 to 1.58, the negative ions being invariably the more mobile. He inquires whether this peculiarity can be brought into harmony with the conductivities of the various gases for point discharges. It is well known that oxygen does not encourage negative discharges more than positive ones. Sieveking found, in fact, that a positively charged point discharges more easily in oxygen than a negatively charged point. In nitrogen, on the other hand, the negative current is several times, and according to Warburg, several hundred times stronger than the positive current. As the ionic velocity is always greater for negative than for positive ions, it follows that these velocities cannot be the determining element in facilitating the discharge. He suggests other determining elements, such as dust, disintegration, occlusion and chemical attack.—*Phys. Zeit.*, Nov. 1; abstracted in Lond. *Elec.*, Nov. 15.

Model Imitating the Behavior of Dielectrics.—Buchanan.—An abstract of a British Phys. Soc. paper on the model, described recently by Fleming and Ashton. The action of this model depends on the viscosity of a liquid, and the diagrams derived from it show by their form that the motion of the pencil which traces them, approximates closely to what may be expressed by the term "motion of a viscous fluid by diffusion." The present author shows that the motion of the model and the diffusion of electricity in a dieletcric are subject to one and the same mathematical law. He suggests that the inventors should obtain hysteresis diagrams by cyclical loading of the springs. In the discussion, Fleming said that there might be something more than a mathematical analogy between the theory of the model and that of diffusion in a cable. He would like to know if a dielectric has a true conductivity, and suggested that experiments should be made by subjecting a dielectric to constant electric pressure at constant temperature, for years if necessary, and observing whether the curve of current becomes asymptotic to the zero line or to a line parallel to it. The model could be made to represent a conduction as well as a displacement current by so arranging the bottom piston that it could descend but not return. The fact that the movements of the model were similar to the diffusion of current in a cable, suggested that the process of conduction in a metal is similar to that of displacement in a dielectric.—Lond. *Elec.*, Nov. 15.

Chemical Effect of Radium Rays.—Becquerel.—In connection with the chemical actions, described by Berthelot, the present author mentions several more. The photographic action of Becquerel rays is well known, and was indeed the property which led to their discovery; but it must be noted that though uranium and radium rays act upon silver gelatino-bromide, they produce no effect upon Daguerre plates or upon some photographic papers. The coloring of glass, porcelain, paper and certain crystals, as well as the painful physiological effects of radium rays upon the skin, also belong to this class of phenomena. Three new cases have been discovered by the author. One is the exothermic transformation of white phosphorous into red phosphorous in about 24 hours, another is the reduction of mercuric chloride in the presence of oxalic acid, with precipitation of calomel, and the third is the destruction of the germinating power of seeds by prolonged exposure to radium rays. A week's exposure is amply sufficient to deprive the seeds of mustard and cress of their powers of germination.—*Comptes Rendus*, Nov. 4; abstracted in Lond. *Elec.*, Nov. 22.

Thunderstorm Indicator and Recorder.—Odenbach.—An illustrated description in detail of an instrument devised and tried by him for detecting an approaching thunderstorm and recording the electromagnetic waves. It consists of a coherer, a relay, a sounder which acts at the same time as decoherer, an induction coil, two condensers and two batteries of two and four dry cells. With an older form he made extended observations in the meterological observatory of St. Ignatius College, in Cleveland. He could detect an approaching thunderstorm at least an hour earlier, but generally several hours earlier, so that there is time to warn tugs, fishing boats, yachts. A new form of his instrument is still better.—*West. Elec.*, Nov. 30.

Secular Variation of the Earth's Magnetism.—Raulin.—A paper in which he claims to have discovered a revolution of the north magnetic pole about the geographical pole along the 70th parallel of latitude, and maintains that such a revolution would explain all the secular variation observations made in Europe and in the Atlantic. He suggests as a cause of this motion a lagging of the liquid or viscous center of the earth behind the crust in its revolution towards the east.—*Comptes Rendus*, Nov. 4; abstracted in Lond. *Elec.*, Nov. 22.

Electro-Chemistry and Batteries.

Purification of Water by Ozone.—Erlwein.—A long illustrated article on the experiments made by Siemens & Halske in an experimental station for the use of ozone for the purification of 250 cubic meters of water per day. The experiments have extended over three years and have been very successful. The water is first cleaned from the suspended dirt by passing it through a quick filter. It then flows into small brick towers filled with gravel. While it flows down through the gravel, it is subjected to the action of the ascending ozone. For making the ozone, Siemens plate and tube apparatus are used, which are operated at 8,000 to 12,000 volts and yield on the average 20 to 25 grams of ozone per hp-hour, with an ozone concentration of 2 to 3-gram per cubic meter of ozonized air. The bacteriological results of the experiments were as follows: The raw water contained 100,000 to 600,000 germs per cubic centimeter; it could sometimes be entirely sterilized, and in all cases the number of germs

was reduced to 2 to 9 per cubic centimeter, which is far below the number regarded in practice as permissible, namely, 100 germs per cb. cm. The consumption of ozone per cubic meter of sterilized water is 2 grams. The total cost of sterilizing 1 cubic meter of water, including cost of operation, interest and amortisation, is 1.26 cents. The ozone apparatus consists of pairs of plates placed above one another and insulated from each other; the metal is at one side and glass with tinfoil at the other; they are connected to the high-tension poles and dried air is driven through the discharge space. The construction and arrangement of the plant is described in detail and illustrated.—*Schilling's Journ. fuer Gasbel. u. Wasservers.*, v. 44, No. 30, 31; *Die Gesundheit*, 1901, No. 15.

Electrolytic Production of Oxygen and Hydrogen.—A note on the Schuckert electrolyzer which consists of a cast iron tank containing a large number of iron bells, one of these latter being used to cover each electrode and to collect the gas liberated at its surface. A 15 per cent solution of caustic soda is used as electrolyte, and a continuous feed of distilled water is required to replace that decomposed by the electric current. The best efficiency is obtained with this apparatus at 70 degs. C. with an e. m. f. of 2.8 volts, and in order to guard against loss of heat the electrolyzer is embedded in a wooden box filled with dry sand. Rubber tubing is used to conduct the gases from the "bells" to the gas-holders, rubber being used to prevent short circuitings between the latter and the cell. An installation with 40 electrolyzers, each producing per hour 220 litres hydrogen and 110 liters oxygen, costs $4,500. If power costs $37.50 per kw-year, the total cost, including the compressing for storage in cylinders, is given as 2 cents per 7 cubic meters of gas. The use of hydrogen gas, in gas engines of special design, as a motive agent for motor cars is thought likely to receive practical study now that a supply of compressed gas at low rates is at the demand of motor-car engineers.—Lond. *Elec.*, Nov. 22.

Alkali Industry.—SEIBERT.—A summary of several processes in actual use. The different steps of diaphragm processes with aqueous solutions are described and illustrated. The Kellner process with mercury cathodes is briefly mentioned; also the Acker process with fused electrolyte and fused lead cathode. He gives a plan for the installation of a plant for electrolysis of brine solutions with diaphragm and iron cathodes; the cost of operation, wages, interest and amortisation, for producing daily 10,000 kgr. of solid KOH of 91 per cent and 15,500 kgr. of chloride of calcium with 35 per cent of active chlorine, is estimated to be $986 per day.—*Elektrochem. Zeit.*, Nov.

Persulphate Cell.—PETERS.—A continuation of his series on experiments with primary batteries. He recommends the use of persulphates as depolarizers, or mixed with other depolarizers. He gives the results of tests made with two dry cells, one containing the ordinary depolarizer, the other a mixture of it with ammonium persulphate. The latter has a higher e. m. f. and a greater capacity, and when it has given out current, it regains its initial e. m. f. in a shorter time.—*Centralblatt. f. Accum.*, Oct. 15.

Catalysis.—OSTWALD.—An interesting and systematic review of the numerous different cases of "catalysis"; i. e., those in which the development of a chemical reaction depends upon the presence of another body or material which, however, does not give the energy required for the reaction, nor enters into the reaction at all. In general a catalyzer may be regarded as a material which, by its presence, changes the speed of chemical action, and causes the chemical system to change from a less stable condition to a more stable condition.—*Zeit. f. Elektrochemie*, Nov. 14.

REFERENCES.

Theory of Ions.—PAUL and HIS.—Two papers read before the Association of German Naturalists and Physicians, the one by Paul on the importance of the theory of ions for physiological chemistry, the other by His on the importance of the theory of ions for clinical medicine.—*Zeit. f. Elektrochemie*, Nov. 7.

Storage Battery Factories in Prussia.—HEFFTER.—An abstract of the report of the Prussian Board of Trade on the storage battery manufacturing plants. There are 30 such factories in Prussia, having together 2196 workingmen. As sanitary rules are enforced, the number of lead poisoning cases has decreased.—*Centralblatt. f. Accum.*, Nov. 1.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Alternating-Current Terminology.—A communication, recommending the suppression of the effective values of alternating waves. He prefers a voltmeter and an ammeter which give directly the "active" values, where the "active e. m. f." is defined as the effective e. m. f. multiplied by the square root of the power factor. The product of active e. m. f. and active current give directly the true power.—*L'Ind. Elec.*, Nov. 10.

Wehnelt Interrupter.—CODD.—An illustated description of some experiments with the Wehnelt interrupter. By using two breaks in series the spark length can be increased, especially with certain coils which have a comparatively high self-induction. In some cases the spark length may be doubled, and the current in the primary considerably diminished. The spark obtained from the secondary is not so heavy as that obtained by the use of a single break, yet is sufficient to work a Crookes tube in the way that an ordinary single Wehnelt break would work it, when using a larger coil. The effect of the two breaks in series is not so marked at comparatively low voltages. When the electrolyte becomes warm, the interrupter ceases to work, or fatigues. This is shown to be due to heating only, and the limiting temperature is within 1 or 2 degs. of 75 deg. C.—Lond. *Elec. Rev.*, Nov. 15.

Interrupter for Induction Coils.—TURPAIN.—An illustrated French Ass'n Adv. Sc. paper. When a Ruhmkorff coil is supplied with direct current, interrupted by means of an ordinary Foucault or Wehnelt interrupter, the e. m. f.'s at the moment of closing and breaking the circuit differ greatly. To make the dissymmetry of the e. m. f. curve disappear, it is sufficient to reverse the direction of the primary current after each interruption. He describes a simple device for this purpose.—*L'Eclairage Elec.*, Nov. 2.

REFERENCE.

Permeameter.—BAILY.—His Brit. Ass'n paper in full, with illustrations, on a direct-reading permeameter, an abstract of which was noticed before in the Digest.—Lond. *Elec.*, Nov. 22.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Tables for Conversion of Rates of Cable-Speed.—RAYMOND-BARKER.—The trouble taken and time devoted at up-to-date cable stations, in the compilation and maintenance of reliable speed tables based on half-hourly chronometric observations, afford testimony of the importance attached by modern cable experts to the correct expression of cable-speed rates in tables constituting thereafter an ever-present incentive to maximum efficiency. He gives a table of multipliers by which statements of telegraphic speeds, whether in siphon recorder or in Morse codes, may be reduced from one mode of expression to another with due regard to the varying space factor. He also gives some explanatory examples. The criterion by which the signaling capacity of any given cable should be judged is the maximum number of legible letters which can be signaled in a given time expressed, with due regard to the variable space factor, in terms of words of that number of letters which previous experience has taught one to expect in certain given classes of traffic, viz., 5-letter words in the case of press traffic and 8-letter words for commercial code.—Lond. *Elec. Rev.*, Nov. 22.

REFERENCES.

Central Battery System.—TOBLER.—An illustrated article on some recent improvements of the central battery.—*Jour. Teleg.*, Oct. 25.

New Series Alternating Current System.

The Helios-Upton Company is placing on the market a new type of regulator for alternating-current series arc circuits, which consists of an impedance coil in which the impedance is varied automatically by changing the relation of the iron core to the coil, this impedance coil being in series coil with the lamps. This form of regulator is claimed to have many things to recommend it over the constant-current transformer. It can be used directly upon the primary circuit without any transformation, if so desired, which would give the system a greater efficiency, and it can be made extremely simple in construction. The type illustrated is one in which the simplicity of construction has been carried out to the greatest refinement. It consists simply of two coils which are supported horizontally on a pivot above them, so that they can swing up on an incline U-shaped iron core. These coils are drawn up by their own attraction to such a point that their impedance always keeps the current constant. This is accomplished largely by the weight of the coil as an opposing force and a small weight, used only as an adjustment.

The advantage claimed for this construction is that the regulator

is very much more compact, and on account of dispensing with the large counterweight that has been used previously, the susceptibility to changes of load is very much increased by removing a large part of the weight from the supporting pivots.

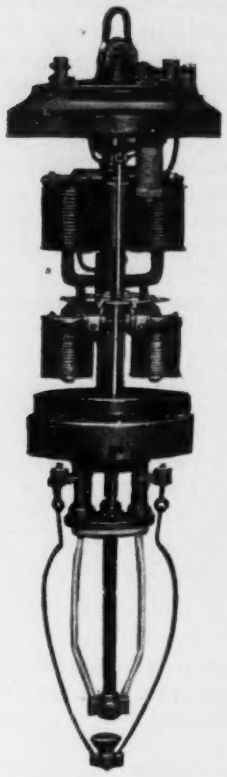


FIG. 1.—LAMP.

For use with the regulator the differential type of lamp has been adopted. Among the advantages of this lamp are that it can be made extremely simple, having only a mechanical cut-out. When the lamp is not burning, the carbons are together, and consequently no amount of jarring when the lamp is not in operation, will interfere with its start when the current is thrown on. Besides this, a differential lamp helps to regulate the circuit, so that no oscillation of current can possibly occur. The only objection that can be used against it is the small additional loss in the series coil and its non-adjustment to current changes without readjusting, which points are considered of such small moment in comparison with the superior operating qualities, that this type was adopted as superior to the shunt type.

This lamp is shown in Fig. 1. It consists of four coils mounted on a central tube, the series coils being above and the shunt coils below. They act on two U-shaped laminated cores connected together. These cores, through the medium of a flat spring, are connected with the clutch rod which lifts the carbons directly. To reduce the loss in the series coil to a minimum, consistent with good operation, the weight of these plungers is counterbalanced by a weight.

The lamp has an outside cable connection with the upper carbon holder, and a number of other good features. The cut-out is purely a mechanical one, and the inner globe is of the closed type with a simple device for holding it in place, so that the trimming of the lamp is a very simple matter.

The object of the Helios-Upton Company in designing this system

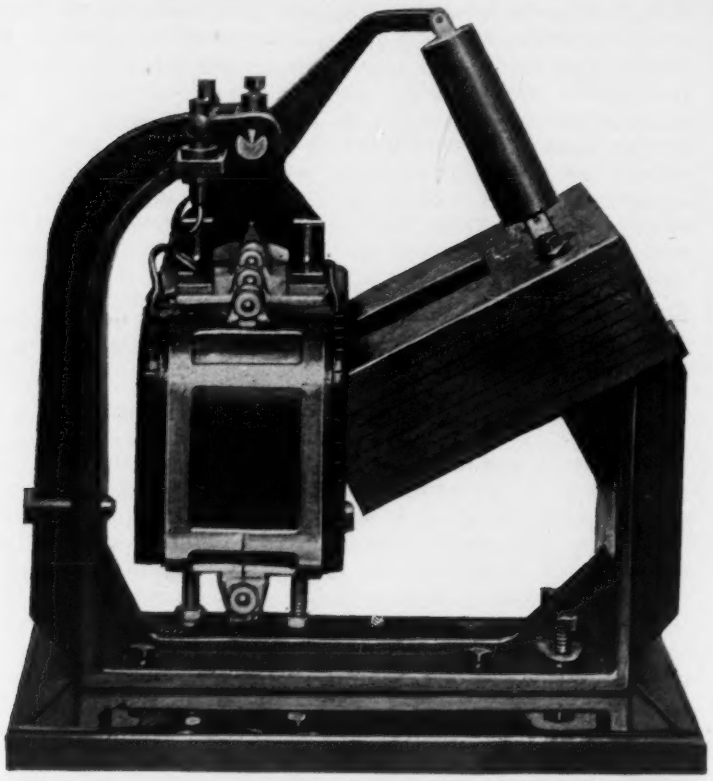


FIG. 2.—REGULATOR.

was not to obtain the greatest economy and the highest power factor, but to produce a system that would always operate well, for it is well known that when great economy has been obtained by delicacy of operation it has always led to disaster. A conservative middle course has always been found the best.

Fuse Plug Cabinet Panels.

In all modern buildings the electric systems require controlling panels at the various centers of distribution. Inasmuch as the type of cut-out known as the Edison fuse plug has been widely adopted in the wiring of buildings, it is a natural consequence that a line of cabinet panels should be brought out by the General Electric Company, embodying the same idea in connection with the necessary switches constituting a panel controlling the circuits at any center of distribution. The general designs of these are indicated by the illustration. The entire line has been approved by the Board of Underwriters.

As indicated above, the most important feature in connection with these panels is the use of the Edison fuse plug, which permits a compact arrangement of great convenience. These plugs are easily connected by any one, without danger, and the operation, as is well known, does not necessitate the use of any tools whatever, while repeated tests show that the plugs will safely interrupt short circuits and confine the arc to the interior of the plug. They are now made for 125 and 250 volts. The various metal parts are designed with

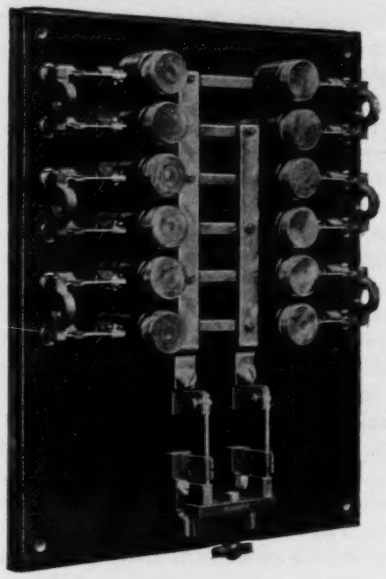


FIG. 1.—CABINET PANEL.

FIG. 2.—PLUG.

ample cross section, the standard capacity for this work being, however, 15 amperes. The metal parts are mounted on a black enameled slate base, the whole being finished in a manner suitable for installation in buildings of the finest construction.

The standard line of panels, which can, of course, be supplied much more quickly than special panels, have the following arrangements of circuits: Two-wire mains with right, left or double branches, 2 to 20 circuits; three-wire mains, with two-wire right, left or double branches, 2 to 20 circuits; three-wire mains with three-wire double branches, 2 to 20 circuits.

The mains are brought to the bus-bars through cable terminals or knife blade switches with cable terminals. When desired, cabinets for these panels can be furnished.

Dynamotors for Telephonic Signaling.

With the gradual introduction of the central energy system into telephone exchanges, there has arisen an increasing demand for dynamotors and motor-generators to perform the work of transforming the available electric current, whether that of a storage battery or electrical supply circuit, into a current of the proper character to perform the work of ringing or signaling. These machines are to perform from the central office the work hitherto done by the individual magneto. The cut represents a form of dynamotor recently placed upon the market by the Holtzer-Cabot Electric Company, of Boston, Mass., constructed especially for this class of work. It

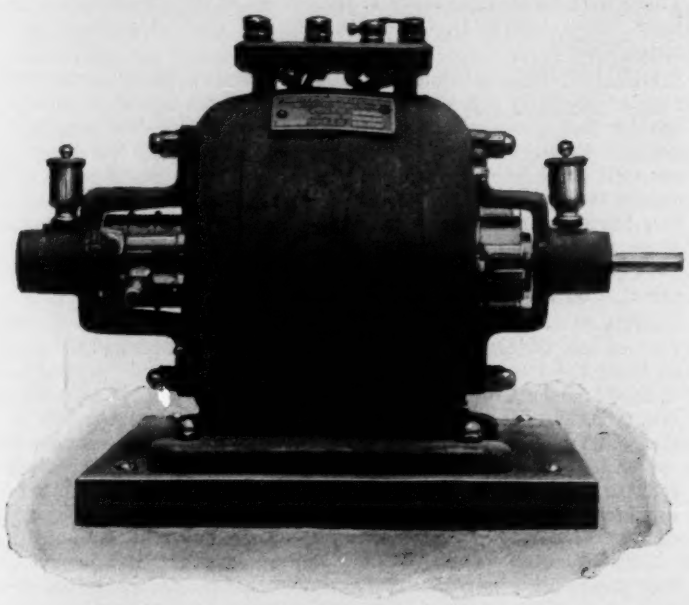
may be used advantageously wherever the source of supply is of the direct-current variety.

The armature is double wound, one winding taking current from the primary circuit and driving the machine as a motor, the other operating as a dynamo and delivering the current for ringing. It will thus be seen that the primary or supply circuit is brought very close to the secondary or ringing circuit in the armature of the dynamotor. In the case of high voltages, such as 500 or 600 volts, there is a possibility of a "cross" or metallic connection forming in the armature, thus placing the supply circuit and the ringing circuit in electrical connection, which might give rise to unpleasant results. For this reason, it is considered discreet in the case of voltages above 220 to use two machines coupled and thoroughly insulated from each other.

The pole piece and poles of these ringers are of soft steel and the armature is of the drum type, laminated and slotted. This the makers consider to be a distinct advance, the drum winding being far superior to the ring winding in this as in most classes of electrical machinery. The drum winding gives a much higher proportion of active wire, and the required voltage may be secured with less weight of wire on the armature. The output is thus increased by reason of the resistance and self-induction of the armature being greatly reduced.

The brush studs are held by a ring, which is held in a machined seat in the end case, thus allowing the brushes to be readily adjusted. The brush holders, commutator and collector rings are designed looking especially to minimum attention and long wear. It will be observed that a third collector ring appears at the secondary end. This is a split ring, which is connected to the secondary winding in such a way as to give a pulsating current; that is, it delivers but half of each cycle. Leads are brought from the brushes of the secondary windings to four binding posts, the arrangement being made as follows: No. 1 to No. 2, alternating current; No. 1 to No. 3, pulsating current, No. 1 being negative with respect to No. 3; No. 1 to No. 4, pulsating current, one in each case being positive with respect to No. 4.

This pulsating current is used in selective party line signaling in connection with a bell of special construction which will respond only to the pulsating wave. With this attachment upon the generator it is possible to greatly increase the number of subscribers that may be selectively called, thus adding to the scope of the party-line system. The alternating-current winding is usually proportioned to give 80 volts, and as the field is of the bipolar type and the speed usually 1000 r. p. m., the frequency will be 1000 cycles per minute, which will ring satisfactorily through a toll line of 100 miles. The pulsating voltages are usually about 60 volts. As stated, the machine shown may only be operated on direct-current circuits. In cases in which there is only alternating current available, it becomes necessary to use a combination of two machines connected together, one being the alternating current motor and the other the generator. This will be similar in appearance to the one shown, the direct-current winding being used in this case to supply current to the fields of the generator.



DYNAMOTOR.

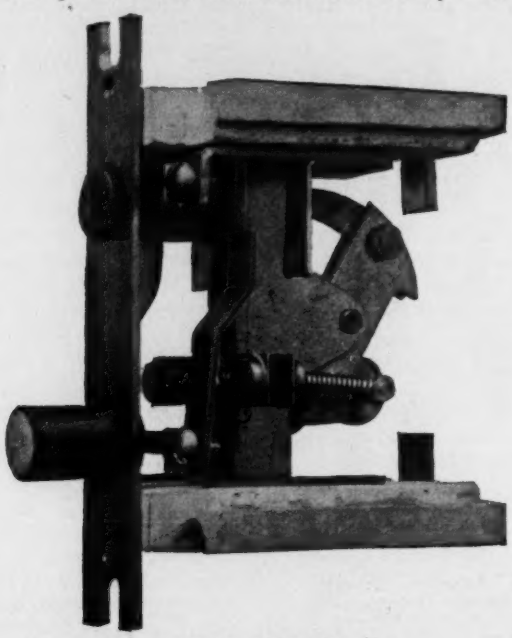
New Push-Button Switch.

One of the minor devices of the electric art involving a good many more problems than appear "on the surface," using that phrase both figuratively and literally, is the push-button switch, and it requires considerable ingenuity to deal satisfactorily with the subject. In the accompanying illustration a form is shown which has lately been put upon the market by the General Incandescent Arc Light Company, and its inventor, it will be seen, has aimed specifically at the points calling for attention in order that the device should give proper results and stand up to the work imposed upon it.

The switch herewith shown is so designed so that the contacts are mounted on separate blocks of porcelain, which being straight, can be moulded in such a way as will insure absolute uniformity after baking. Should the porcelain parts of the G. I. switch become broken, it is very easy to replace them without disturbing any of the other parts of the switch.

The contacts of the switch have a capacity of more than twice the rated capacity (10 amperes), and the moving contacts being in themselves movable, so adjust themselves as to insure perfect contact and afford necessarily a safe carrying capacity. The operation of the switch is such that the movable contacts tend to clean themselves, and thus insure continued good contact.

The mechanism of the switch is of a simple but peculiar construction, which insures absolute certainty of a quick make and break of the contact parts. After the buttons have been pushed a certain distance the making and breaking of the contacts is absolutely beyond the control of the operator's hand. This special construction has the further advantage of avoiding the possibility of a switch being left on any dead center.



NEW PUSH-BUTTON SWITCH.

These switches are made with specially designed tools, insuring absolute interchangeability of parts and the desirable feature that repairs may be readily made by inexperienced people. This in many cases avoids the expense of a new switch. The switch is also designed with an unusually large break distance, so that it may be used with perfect safety on 250-volt circuits.

The switch has a removable cover, giving easy access to the working parts so that the operation of them can be easily seen, and should adjustment be necessary, can be readily made. In this respect the G. I. switch has a great advantage, it is claimed, over ordinary switches enclosed in the usual type of porcelain boxes, since in the latter type of switch it is difficult to tell whether or not the contacts are operating properly and without undue heating, while they are inaccessible should adjustment be necessary. The switches are furnished with the metal face plates of any finish desired, and are designed to go into any standard switch outlet box that will fit any of the other makes of standard push-button switches on the market.

The connections of leading-in wires to the switch are very readily made, since the contact screws are easily accessible, and ample space is allowed for wires. All switches are thoroughly tested with double their rated capacity before leaving the factory.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Call money closed nominally at 4 per cent; time money, which showed a firm tendency, closing at 4 per cent for 60 to 90 days, 4½ for four months and 4½ to 4¾ for 5 to 6 months. Stock values declined on selling induced by the harder tone of the local money market. The heaviness of the market continued throughout the week up to its close, in spite of the strength exhibited by Manhattan Elevated and a few other leading stocks. One of the disturbing elements was Amalgamated Copper, which broke to 69⅞, while copper stocks and copper prices abroad are also badly demoralized. Manhattan advanced to 145 on the strength of divers favorable reports concerning the property, but on Friday the stock had relapsed to a condition of extreme weakness, heavy realizing sales carrying the price down to 135¾. General Electric was conspicuous by reason of its advance to 289¾, based on reports that a large stock dividend might be declared. The week's range of prices was between 275½ and 289¾, the closing figure being 280⅛—a net gain of 2⅝ points. The sale aggregated 21,400 shares. Western Union fluctuated between 91 and 93, closing at the lower figure. Brooklyn Rapid Transit showed some weakness, closing at 63, one point lower than last week's closing quotation. The sales were 87,685 shares. Metropolitan Street Railway also shared the weakness of the general market, closing with a net loss of 5⅛ points, at 160½, the extreme prices being 160⅛ and 167¾. The sales aggregated 48,300 shares. Westinghouse Electric & Manufacturing Company, which is now listed on the New York Stock Exchange, closed at 149½, the sales for the week aggregating 3400 shares. Following are the closing quotations of Tuesday, Dec. 10:

NEW YORK.

	Dec. 3.	Dec. 10.		Dec. 3.	Dec. 10.
American Tel. & Cable...	—	—	General Electric.....	276¼	282
American Dist. Tel.....	—	—	General Carriage.....	1	1¾
Brooklyn Rapid Transit..	63	62¼	Hudson River Tel.....	112	110
Ches. & Pot. Telephone..	67	66	Metropolitan Street Ry..	164⅛	159
Commercial Cable.....	—	—	N. E. Elec. Veh. Tran...	—	—
Electric Boat.....	19	19	N. Y. Elec. Veh. Tran...	11	10
Electric Boat pfd.....	45	40	N. Y. & N. J. Tel.....	167	167
Electric Lead Reduc'n...	1⅞	1⅞	Tel. & Tel. Co. of Am...	—	—
Electric Vehicle.....	2¾	2½	Western Union Tel.....	91⅛	91⅛
Electric Vehicle pfd.....	5	4½	West. E. & M. Co.....	—	148½

BOSTON.

	Dec. 3.	Dec. 10.		Dec. 3.	Dec. 10.
Am. Tel. & Tel.....	160	160½	Mexican Telephone.....	2	2
Cumberland Telephone...	—	—	New England Telephone.	133*	132
Boston Electric Light....	—	—	Westinghouse Elec.....	—	*74½
Erie Telephone.....	16	16	Westinghouse Elec. pfd.	—	—
General Electric pfd.....	—	—			

PHILADELPHIA.

	Dec. 3.	Dec. 10.		Dec. 3.	Dec. 10.
American Railways.....	44⅝	44	Phila. Traction.....	97½	97¾
Electric Storage Battery.	64	61	Philadelphia Electric....	4¾	4½
Elec. Storage Batt'y pfd.	64	61	Pa. Electric Vehicle.....	¾	¾
Elec. Co. of America....	6⅛	6⅛	Pa. Elec. Veh. pfd.....	1	1⅝

CHICAGO.

	Dec. 3.	Dec. 10.		Dec. 3.	Dec. 10.
Central Union Telephone.	—	—	National Carbon pfd....	83	84*
Chicago Edison.....	160	155	Northwest Elev. com....	—	36½
Chicago City Ry.....	185	185½	Union Traction.....	—	10½
Chicago Telep. Co.....	—	240	Union Traction pfd.....	—	47
National Carbon.....	19	20			

*Asked.

ERIE TELEPHONE FINANCES.—It is stated from Boston that the Erie Telephone notes for $9,000,000 will be paid on Jan. 10, and that there is every prospect that important banking interests will undertake the reorganization of the Erie Telephone Company. It is also stated that no plan for a reorganization has been evolved. Sufficient is known, however, to make it plain that an assessment of at least $25 per share on Erie Telephone stock will be levied through the means of a new company, to the securities of which company Erie stockholders will be invited to subscribe at a price which will amount to an assessment of about $25 per share. They may be invited to subscribe to a preferred stock issue, and receive a bonus in common stock. It is said to be very unlikely that Mr. C. W. Morse will interfere with the proposed reorganization. Boston financiers identified with the Bell Company now hold Erie's $9,000,000 of floating debt, and the control of the company, without, so far as is known, any substantial ownerships in the stock. Mr. Morse, by reason of his control of the Bell opposition company—the Telephone, Telegraph & Cable Company of America—represents 21,000 shares of Erie stock, or nearly one-third of its capital. It is still an open question if he was not also the purchaser of 30,000 shares of Erie stock thrown over by the Lowell people at about $60 per share. If Mr. Morse really owns a majority of the Erie stock, he persistently refuses to reveal his ownership or control. He has, however, opposed the partition of the property by the sale of the Michigan Telephone Company to local people in Michigan who desire to secure it, as noted recently in these columns.

BIG PITTSBURG CONSOLIDATION.—The stockholders of the Philadelphia Company met at Pittsburg on Dec. 4 to conclude one of the largest deals in the history of the company, as well as in the financial world of Pittsburg. It was proposed to conclude negotiations by which all but one traction line in Allegheny County—the West End Company—will come under the control of the Philadelphia Company. The stockholders also voted on increasing the capital stock of the company from $21,000,000 to $36,000,000, and the authorized bond issue from $6,500,000 to $22,000,000. When the meeting had adjourned it was announced that the several propositions were unanimously voted for, and the traction, lighting and heating combine for Allegheny County was completed. The new regime will commence Jan. 1 next. Of the 375,460 shares of the company, 302,808 were voted. Separate meetings were held. The first meeting voted to increase the capital stock by $15,000,000 common shares; the second voted to issue the $22,000,000 in bonds, and the third meeting voted to approve the several leases. The Widener-Elkins syndicate did not vote its holdings for an additional director on the board. This matter was deferred until some future time. There were no changes made in the officers of the Philadelphia Company. It is said J. D. Callery will be the general manager of the consolidation.

DIVIDENDS.—Commercial Cable directors have declared the regular quarterly dividend of 1¾ per cent and a bonus of 1 per cent payable Jan. 2 to stockholders of record on Dec. 20. The directors of General Electric have declared the regular quarterly dividend of 2 per cent on the common stock. The dividend is payable Jan. 15 to stockholders of record Dec. 31. The Philadelphia Company directors have declared the usual dividend of 1½ per cent on the common stock, payable Jan. 15. The directors of the Twin City Rapid Transit Company have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable Jan. 2.

CHICAGO TELEPHONE EXPANSION.—The board of directors of the Chicago Telephone Company, at a meeting Dec. 4, instructed the treasurer to offer for subscription at par 30,000 shares of stock of the Chicago Telephone Company to stockholders of record, 3 P. M., Jan. 11, 1902, pro rata to their respective holdings on that date. Each stockholder will be entitled to purchase one share for each three shares of his holdings. This will give the company $3,000,000 more capital with which to increase and extend its service in Chicago, especially in increasing its nickel service in the residence districts.

STROWGER AUTOMATIC.—A telegram from Chicago states that papers have been sent to Springfield for the incorporation of the Automatic Electric Company, with a capital of $2,000,000. It has secured manufacturing rights for the United States, and the plant of the Strowger Automatic Telephone Exchange. The incorporators are Edwin W. Gearhart, James C. Law, Albert G. Wheeler, Jr., Thomas H. Watkins, Scranton, Pa.; Charles E. Eddy, Alamogordo, N. H., and J. B. Russell & Co., bankers, of Wilkesbarre, Pa.

VULCANIZED FIBER CONSOLIDATION.—The American Vulcanized Fiber Company, of New York City, to manufacture and deal in vulcanized fiber, has been incorporated at Dover, Del., with a capitalization of $3,400,000. This is a consolidation of all the fiber companies of the United States, except two. The incorporators are Richard B. Constance, Frank L. Arnold and C. Arthur Coon, of New York City; Gardner W. Kimball and J. Ernest Smith, of Wilmington, Del. Details have already appeared in these columns.

BOSTON EDISON ILLUMINATING.—At the adjourned meeting of the stockholders of the Edison Electric Illuminating Company, of Boston, it was voted to increase the capital stock of the company from $7,102,700 to $7,850,400, and the number of shares from 71,027 to 78,504. Net stock is offered to stockholders of record Dec. 4, 1901, at $200 per share, at rate of two new shares for every 19 old shares now held.

WESTINGHOUSE STOCK ON NEW YORK MARKET.—During the past week the stock of Westinghouse Electric & Manufacturing Company was listed on the New York Stock Exchange, and will be regularly dealt in hereafter.

CALIFORNIA LIGHTING.—We note the incorporation of the California Gas & Electric Corporation, capital $30,000,000, to furnish light to all cities near San Francisco.

PENNSYLVANIA ELECTRIC VEHICLE.—It is announced that the Pennsylvania Electric Vehicle Company will reduce the par value of its $6,000,000 capital stock from $50 to $10 a share.

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Commercial Intelligence.

THE WEEK IN TRADE.—In reviewing the trade conditions *Bradstreet's* says that the retail distribution stimulated by the cold weather and holiday influences has been very large. The holiday trade, in fact, promises to be of unprecedented volume with demand for a better class of goods. In the great industries such as iron, coal, lumber, etc., activity has been widespread. The demand for iron at the highest prices of the year, except in wire and nails, has been limited only by the question of obtaining supplies. A switchmen's strike affects Pittsburg and aggravates the car shortage trouble. Some mills are closed for want of steel, and some furnaces for want of fuel, while merchant furnaces are reported running only half their capacity. Plates are stronger and structural mills are crowded with orders. Orders for railroad cars are very heavy, hardware is in good demand, copper is unsettled, and the tin boom has collapsed. The number of failures for the week, as reported by *Bradstreet's*, aggregated 237, as against 189 the week previous, and 224 the same week last year. There were fewer failures in November than in October, but the liabilities were larger. On the other hand, compared with November last year the failures are more numerous, while the liabilities are smaller. Owing to the depreciation of the principal copper stock, interest in the copper situation has become more acute; as to active trade conditions, however, the situation is unchanged. Prices remain unaltered, Lake being quoted at 16¾c., electrolytic 16.30 to 16⅝c., and casting stock 15⅝ to 16⅝c.

ROCKINGHAM COUNTY LIGHT & POWER COMPANY'S PLANT.—Sanderson & Porter, engineers and contractors, of 31 Nassau Street, New York City, have just determined on the contracts for the equipment of the Rockingham County Light & Power Company's plant at Portsmouth, N. H. The initial installation will be capable of developing 2500 kw, but the buildings have been planned so as to permit of the capacity being trebled, which it is stated will be an accomplished fact in the near future. The company —in which prominent New York and Boston capitalists are said to be interested—proposes to light the city of Portland and to feed some 150 miles of street railways in that vicinity through 12 sub-stations. The central power plant is to be equipped with five 520-hp Cahall boilers, ordered from Thayer & Co., Incorporated, of 39-41 Cortlandt Street, and to be built by the Aultman & Taylor Machinery Company. Westinghouse, Church, Kerr & Co. have secured the contract for the mechanical stokers, which will be of Roney make. The gravity buckets and conveyers are to be furnished by the Link Belt Engineering Company, of Nicetown, Pa. The International Pump Company is to supply a Blake compound duplex plunger type 10 by 16 by 8 by 12 pump, also a 14 by 20 by 26 by 24-inch stroke circulating compound duplex pump of the same manufacture. The Worthington branch of the International Pump Company has secured the order for a 36-inch elevated central condenser. The two main engines each having a capacity of 1600 hp, will be of the Rice & Sargent type. These machines will be manufactured at the Providence (R. I.) Engineering Works. The auxiliary engines to be utilized for exciting purposes are to be 12-inch vertical compound Westinghouse machines. The lighting engine—an 18-inch vertical compound machine—will be of Westinghouse build. The General Electric Co. has been awarded the contract for furnishing two 1000-kw, 13,200-volt, three-phase, 25-cycle, and 94 r. p. m. units. The same concern has also obtained an order for two 100-kw, 125-volt exciters, each to be connected to the 12-inch Westinghouse engines. The large generators will be direct connected to the Rice & Sargent engines. There will also be two 200-kw G. E. 60-cycle, two-phase, 2300-volt alternators for lighting, one of which will be direct connected to the 78-inch Westinghouse engine, while the other will be driven by a motor. The plant will, it is stated, entail an expenditure of fully $500,000 before completion. The steel for the buildings—about 350 tons—is being supplied by the American Bridge Company. It is expected that everything will be in readiness to begin active operations by May, 1902.

THE SITUATION IN COPPER.—He is a wise man who can make head or tail of the present copper situation, but if all that is going on has any industrial significance at all, it would seem to imply that copper may go lower, though not very much. We quote D. Houston & Co.'s recent circular as follows: There has been a very large business done in copper since our last circular on basis of recent market quotations, with deliveries up to next April, and said to aggregate 85,000,000 to 100,000,000 lbs.; but the understanding is that the contracts include certain conditions which may be considered equivalent to a guarantee. These recent important sales have consequently taken a very large quantity of copper off the market. Consumption of copper in the United States this year has been on a great scale, and there has been a fast moving current of copper going regularly into the home channels of distribution. The great brass and copper mills of the country have been absorbing millions of pounds of the metal in the aggregate each week in the course of legitimate business. Consumers lately have been compelled to run their works at the maximum capacity, owing to the multiplicity of orders. The home consumption has been at a higher level this year than when copper sold much below present prices, and an increasing American demand for articles of copper and brass manufacture is demonstrated. It is worthy of note that the copper consumers of the world have been operating their establishments on small stocks of copper, and that trade requirements must naturally be in heavy volume between now and spring. The projected new Pacific cable having a total length of 7000 to 8000 miles, will take considerable copper, and new electrical projects on both sides of the Atlantic will also create further demand for copper. Consumption of copper in England and France for the first ten months of this year is returned at 98,838 tons, compared with 104,067 tons for same months in 1900. The amount of foreign copper (pyrites not included) consumed in Germany during the first nine months of this year, is officially reported at 41,522 tons, against 59,375 tons in first nine months last year.

WORK ON NEW YORK METROPOLITAN.—President Vreeland, of Metropolitan Street Railway, says: "Earnings of the Metropolitan lines for the month of November showed an increase of about $40,000 as compared with the corresponding month last year notwithstanding that business is being lost through interruption to traffic caused by the subway work on Fourth Avenue and upper Broadway. The increase for the Third Avenue, 'Huckleberry' and other lines amounted to $28,000. We will finish up our construction work for the year on Dec. 15, and will then have opportunity to consider the work for next year. Early in the spring we will begin to change the lower section of the Ninth Avenue line, which is now operated by horse-power from Fifty-third Street down, and put it in shape for electric operation. The Fourteenth Street line will also be taken up so that it may be used for distribution of traffic from the trunk lines and operated as a part of them. The line runs through a very good business section, and cars from the north and south lines will be run east and west through this thoroughfare as is now being done with good results on Twenty-third and Fifty-ninth streets. The importance of the connections thus made will justify the expense, though it is doubtful if as much could be said in the case of lines further downtown, such as Houston Street or Spring Street, which do not run through such a fine business section. The question of how the money for these improvements is to be provided has not been definitely settled."

DR. F. A. C. PERRINE, the president of the Stanley Electric Manufacturing Company, of Pittsfield, Mass., was in New York last week for the first time after his long trip on the Pacific Coast, where the company has so many notable transmission plants. He brought with him on his return an order for a $150,000 equipment, and speaks most hopefully as to the electric power outlook in California, etc. He knows the region well, having been, as will be remembered, professor of electrical engineering at Leland Stanford, Junior, University. He describes the Bay Counties 200-mile transmission as working admirably, and states that even against the cheap oil now obtainable on the Slope, electricity holds its own; in fact, the Los Angeles Edison Company, which owns oil wells, is extending its water power equipment. Dr. Perrine will, we are happy to learn from him, favor the New York Electrical Society in January with a lecture on the power plants of the Pacific Coast, embodying also his valuable observations made on the ground.

PLANT FOR KEESEVILLE, N. Y.—The Keeseville, Ausable Chasm & Lake Champlain Railroad Company, Keeseville, has been reported by some of our contemporaries as in the market for an electric lighting plant that will supply 6000 16-cp incandescents and 100 arcs of 2000 cp. Turbines will also be needed. Mr. G. N. Kingsland, general manager, writes us, however, that the reports are rather mixed and erroneous. He says: "We are not going to put in a lighting plant, but are contemplating the changing of our system of operation to electricity. Should the plan be carried out, the project is to extend the road up along the bank of the Ausable River to Ausable Forks, Jay, Keene Valley and Lake Placid, a distance of about 60 miles. This route is very picturesque, and would, we think, attract the thousands of tourists who come up into this country in the summer time. We hope to carry out this electric railway scheme in the next 12 months."

THE CLARK AUTOMATIC TELEPHONE SWITCHBOARD COMPANY, of Providence, R. I., has arranged for representation on the Pacific Coast with the Kilbourne & Clark Company; for Hawaii, with Mr. Guy Owens, of Honolulu; for Mexico, with Mr. Louis L. Lomer, and with Mr. J. H. Quick, of Sioux City, for the State of Iowa. Among the recent new contracts that the Clark Automatic Telephone Switchboard Company has received are the Stillings Press, Boston, six stations; Trenton Iron Company, Trenton, N. J., 15 stations; La Salle Academy, Providence, R. I., 24 stations, and E. F. Roth, Wilkesbarre, Pa., 12 stations.

ELECTRIC POWER FOR PACKING PLANT.—The Schwarzschild & Sulzberger Company, large meat packers, at Forty-fifth Street and First Avenue, are shortly to reconstruct their plant in New York on the plan of their Chicago branch, which has just been completed. E. E. Matchette, general manager of the Western interests of the concern, is in New York at the Waldorf, with Samuel B. Weil, vice-president of the company, who are to confer with the board of directors regarding the details to be followed in the reconstruction of the plant. He states that the Chicago plant has already shown such remarkable results from the application of modern machinery and electricity to the packing industry in the saving of labor and expenses, as well as in the utilization of what were formerly waste materials, that it was immediately decided to entirely rebuild the New York plant, following that at Chicago as a model. The plant will be absolutely fireproof and operated by electricity. The building will probably be about eight stories in height, like that in Chicago, the idea being to have the cattle carried to the building when slaughtered, from which point the different parts of the animal are carried down to all sections of the plant by means of gravity chutes, which are labor-saving devices of considerable value. The work of slaughtering and packing will be done almost entirely by machinery, and a saving in power will be effected by the use of a large number of motors, which will do away with the necessity of having all the machinery in motion at once when only part of it is in use. "The packing business has been revolutionized in the past ten years," said Mr. Matchette, "and we find in our Chicago plant a reduction of 25 per cent in the expense of labor alone below that of the methods heretofore employed. The reduction in the expnses of the New York plant, with its present antiquated methods, will be considerably greater." The cost involved in the reconstruction of the New York plant will approximate $850,000, and it will probably take about eight months to put the new methods in operation.

EXPORTS OF ELECTRICAL MATERIAL AND MACHINERY.—The following are the exports of electrical material, machinery, etc., from the port of New York for the week ended Dec. 4: Argentine Republic—124 pkgs. material, $2,465; 1 pkg. machinery, $555. Antwerp—21 pkgs. material, $1,724; 11 pkgs. machinery, $200. Brazil—30 pkgs. material, $505; 3 pkgs. machinery, $200. Bremen—12 pkgs. material, $654; 4 pkgs. machinery, $300; 67 pkgs. wire, $1,690. British Guiana—22 pkgs. material, $376. British West Indies—22 pkgs. material, $193. British East Indies—9 pkgs. material, $88. British Possessions in Africa—1 pkg. machinery, $15. Cuba—120 pkgs. material, $1,740; 1 pkg. wire, $88. Chili—2 pkgs. material, $137. Copenhagen—2 pkgs. material, $56. Central America—14 pkgs. material, $413. Danish West Indies—3 pkgs. material, $33. Frederickstad—36 pkgs. machinery, $720. Glasgow—3 pkgs. machinery, $90. Havre—20 pkgs. material, $776; 1 pkg. machinery, $20. Hamburg—4 pkgs. machinery, $3,910; 44 pkgs. material, $2,045. Leicester—8 pkgs. machinery, $160. Liverpool—47 pkgs. machinery, $6,500; 91 pkgs. material, $7,565. London—126 pkgs. machinery, $1,465; 91 pkgs. material, $7,565. Mexico—249 pkgs. material, $2,072. Newfoundland—11 pkgs. material, $110. Newcastle—19 pkgs. machinery, $3,300; 1 pkg. material, $16. Nantes—1 pkg. machinery, $152. Peru—8 pkgs. material, $300; 1 pkg. india rubber, $65. Rotterdam—5 pkgs. material, $160. Southampton—4 pkgs. material, $157; 27 pkgs. machinery, $2,610. Uruguay—3 pkgs. material, $159. U. S. Colombia—21 pkgs. material, $244. Vienna—1 pkg. machinery, $125. Zurich—1 pkg. material, $86.

ELECTRICAL IRRIGATION PLANT FOR PORTO RICO.—The South Porto Rico Sugar Company, whose New York address is 44 Wall Street, has just let the contract for the pumps, etc., required for irrigation work at its Guanica property, located on the south side of Porto Rico. The contract calls for four rotary pumps of 4,000,000 gallons capacity each. These outfits will be supplied by P. H. & F. M. Roots, of Connersville, Ind., whose New York offices are at 109 Liberty Street. The pumps will be direct connected to General Electric motors. These outfits will operate over an area of three square miles. The irrigation plant, some further particulars of which have already appeared in these columns, will entail an expenditure of $100,000.

WATERWHEEL PLANTS FOR MEXICO.—The Pelton Waterwheel Company, New York offices, Central Building, 143 Liberty Street, has secured a contract calling for the shipment of three 700-hp waterwheels and some 120 tons of pipe to the Toluca Electric Light Company, of Toluca, Mexico, which concern proposes utilizing same for its hydraulic plant. Another Mexican contract just to hand requisitions for a 300-hp waterwheel outfit, including 3200 ft. of pipe. Among recent domestic contracts awarded to the Pelton people is one from the Niagara Falls Power Company, which concern calls for a fair-sized lot of riveted pipe, cast iron columns, etc.

PHILIPPINES PUBLIC PRINTING OFFICE.—The National Electric Supply Company, contractors of complete power and electric plants, of 1417 New York Avenue, Washington, D. C., are at present placing numerous contracts for electrical equipments, etc., intended to be installed in the Philippines Public Printing Office. Barber & Co.'s steamship "Morven," which sailed this week for Manila, carried some hundreds of tons of this material. The National Company's shipments comprised oil tank, pipe and fittings from the Crane Company, Philadelphia; switchboard, etc., furnished by W. H. Weston & Co.; iron conduit supplied by the Sprague Electric Company; motors and dynamo from the Crocker-Wheeler Company; circuit breakers provided by the Cutter Electrical & Manufacturing Company, of Philadelphia; asbestos pipe covering, etc., from the Philip Carey Manufacturing Company, of Lockland, Ohio; boiler from the Erie City Iron Works, of Erie, Pa.; telegraph wire from the Washburn & Moen department of the American Steel & Wire Company; miscellaneous supplies from Patterson, Gottfried & Hunter; drill press and motor, also shaper and motor sent by Gould & Eberhardt, of Newark, N. J., and testing instruments supplied by the Western Electric Company.

THE ST. LOUIS EXPOSITION BIDS.—Representatives of the leading electrical firms of the country were in St. Louis last week obtaining material from which to make bids on work at the Louisiana Purchase Exposition. Among the represetnatives were Guido Pantaleoni, representing the Westinghouse Electric & Manufacturing Company; B. F. Sunny, General Electric Company; C. W. Wetmore, of the North American Electric Manufacturing Company; George Bullock and J. J. Kennedy, the Bullock Electric Manufacturing Company, of Cincinnati; Ernest G. Bruckman, the Imperial Electric Light & Power Company. At a meeting of the Grounds and Buildings Committee four of the competing companies submitted bids for the plant, setting forth in some detail prices and proposals. The bids were only informally considered. Director of Works Taylor, speaking of the needs of the electric plant, said that it was the intention of the World's Fair people to sign a formal contract within the next two weeks. Time is required to build the boilers and engines for so gigantic a plant, and it was their intention to give the contractor an early start.

CONTRACT IN ENGLAND FOR GERMANY.—A cable dispatch from London of Dec. 5 says: There was an interesting discussion before the City Council of Manchester yesterday over a contract of £113,000 for an electrical plant, which it was proposed to give to a German firm, as the lowest British tender was £36,000 higher than the German bid. The chairman of the Council explained that if the difference between the two bids had been but a few thousand pounds, the British firm would have had the contract. A member of the Council proposed that the contract be given to the British Westinghouse Electric Company, Limited, whose tender was £16,000 higher than that of the German firm, as then part of the work would be done in Great Britain. The chairman explained that the Manchester factory of the Westinghouse Company would not be ready until next July, therefore, if the contract were awarded to that company all the work would be done in Pittsburg. The German tender was finally accepted.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has secured the contract for the electrical equipment for the Omaha (Neb.) and Pocatello (Idaho) shops, for the Oregon Short Line Railroad, and the shipping of material and work will commence at once. L. M. Cargo closed the contract for the Westinghouse Company. There will be electric cranes, electric transfer tables, etc., and the engines will be of 400 hp. It will be a very complete outfit. The contract figures for the electrical work are about $60,000 for the Pocatello shops.

BIDS FOR BOISE POWER PLANT.—Bids are asked for by the Boise-Payette River Electric Power, of Boise, Idaho, for the construction of its power plant on the Payette River near Horseshoe Bend. They will include the construction of 3½ miles of canal, ¼ mile of flume, masonry head works, waste gate, culverts, bridges and power house of concrete masonry; the hauling of freight from Boise to the plant, and the distribution of poles on the transmission line from the power house to Boise, and on the branch line to Pearl. Plans and specifications may be procured at the office of the company at Boise, Idaho, or from A. J. Wiley, chief engineer.

THE INTERNATIONAL TELEPHONE MANUFACTURING COMPANY, Chicago, has taken the third, fourth and fifth floors of the B. F. Sturtevant Building, corner of Harrison and Clinton streets, for the manufacture of a complete line of generator call and central energy telephone equipment, for private and public plants of any size. The details as to the management of this enterprise were given in this department last week. An important industry is thus added to the already large representation of independent telephony in Chicago and vicinity.

CINCINNATI RAILWAY ENGINES.—For the new generating equipment of the Cincinnati, Georgetown & Portsmouth Street Railway, Hooven, Owens & Rentschler have been given a contract for two 900-hp cross-compound condensing engines, direct connected.

NILES-BEMENT-POND COMPANY has an order from the Lewis Foundry & Machine Company for a 60-ton double-trolley electric crane for a new factory at Groveton, near Pittsburg.

General News.

THE TELEPHONE.

HOPE, ARK.—A telephone line is being built from Hope to Washington.

SAN FRANCISCO, CALIF.—A new independent telephone company has been incorporated by A. B. Thompson, O. F. Thompson, Jesse Moore, J. B. Saylor, R. N. Stanfield and Dr. C. J. Smith, of Pendleton, Ore. A line will be constructed from Echo, Ore., a station 20 miles north of Pendleton, to Sloan Bros.' Ranch on Butter Creek.

TAMPA, FLA.—The Peninsular Telephone Company has decided to increase its capital to $500,000 to build long distance lines recently decided upon.

OCALA, FLA.—The Ocala Telephone Company uses apparatus of several makes. It operates a 125-drop board and has 119 subscribers. Increase is steady.

DIETERICH, ILL.—It is reported a local telephone company will be organized here.

FREEPORT, ILL.—Messrs. Bills & Wortham have been granted the right to construct a telephone system in Freeport.

NEW HOLLAND, ILL.—The Central Union Telephone Company is building a new line from Buttonview to New Holland.

MACKINAW, ILL.—It is rumored that the Davis telephone system of Tremont, will put in an exchange at this place before long.

STREATOR, ILL.—The officers and stockholders of the Streator Independent Telephone Company have voted to increase the capital stock to $100,000.

NEWTON, ILL.—The Jasper County Mutual Telephone Company, capital stock $5,000, has been incorporated by Wm. Kilgore, R. S. Hunt and J. L. Forester.

ALTON, ILL.—The Calhoun County Telephone Company has decided to extend its lines into St. Louis. S. J. Merida, S. A. White and W. A. Skeel are interested.

ONTARIO, ILL.—The Oneida & Ontario Telephone Company reports business first class. It operates Swedish-American apparatus; has a 100-drop board and 25 subscribers.

HENDERSON, ILL.—The Farmers' Telephone Company has all the business it can manage, and new orders continually arriving. Eureka and Stromberg-Carlson apparatus is used and a 250-drop board supplies 350 subscribers.

CHICAGO, ILL.—Mr. R. F. McPhetridge, 989 West Monroe Street, Chicago, informs us that he is looking for a good location for the purpose of establishing a telephone system. He has in mind a town of from 2000 to 5000 population in the south or southwest.

HIGHLAND, ILL.—The Kinloch Telephone Company has secured from the St. Louis, O'Fallon and Lebanon Electric Railway a right of way for the extension of its telephone over the abandoned roadbed between Lebanon and O'Fallon. The telephone line, which is being extended from Belleville to O'Fallon, will be continued to Lebanon.

JOLIET, ILL.—The directors of the Interstate Independent Telephone & Telegraph Company, a $3,000,000 corporation recently organized in New Jersey for the purpose of acquiring and controlling telephone companies, held its first business meeting here on Nov. 29. Officers were elected as follows: President, Senator H. H. Evans, Aurora, Ill.; vice-president, Frank Tracey, Springfield, Ohio; secretary and general manager, E. R. Conklin, Joliet; treasurer, A. B. Conklin, Aurora. The principal offices will be in New Jersey, with branch offices in Chicago and Aurora.

GRAY, IND.—The Carmel Telephone Company will extend its lines to Gray in the near future.

BLUFFTON, IND.—The contract for the erection of the new exchange building for the United Telephone Company was let to John Barnes & Son, of Logansport.

HAGERSTOWN, IND.—It is proposed to establish an automatic telephone exchange here. The plant now in use is thorough and extensive. Its lines reach Economy, Williamsburg, Cambridge City, Dalton, Greenford and other towns, while many villages are in direct communication.

INDIANAPOLIS, IND.—The Indiana Central Telephone Company has filed articles of incorporation with the Secretary of State, with a capital of $3,800. The directors are John Grimes, Wm. D. Bowers, John Wilson, James and Fletcher Goff. The company is made up of Russellville citizens, who propose to maintain an exchange at Russellville for free communication between stockholders and their friends. A nominal charge will be made to others who receive service.

DUFF CITY, IND.—At a recent meeting here of the "Farmers' Mutual Aid & Benefit Association," the object of which is the suppression of crime and vice and the arrest and conviction of thieves, it was said that the telephone had enabled the members of the association to apprehend thieves to the extent that wrongdoers give this part of the State the go-by. Similar commendation is had from the Indiana Horse Thief and Detective Association. It is now such an easy matter to apprehend, arrest and convict thieves that the attempts to steal horses and get out of the State is scarcely heard of any more. This is largely due to the telephone, it is said.

COUNCIL BLUFFS, IA.—F. H. Eckles, of Tama County, has purchased the Cedar Valley Telephone Company, which runs into Shell Rock.

PANORA, IA.—The Panora Mutual Telephone Company has been organized at this place to operate an exchange and connect with various country lines.

WYOMING, IA.—A telephone company has been organized at this place by Dr. J. W. Kirkpatrick, P. C. Jansen, W. S. Garrison, J. W. Waite and E. M. Babcock.

OGDEN, IA.—The Ogden Telephone Company informs us through Mr. Gardner that Kellogg apparatus is used. It operates a 200-drop board and has 90 subscribers. Growth is steady and the outlook bright.

DES MOINES, IA.—The Mutual Telephone Company increases steadily, and we are informed by the superintendent, Mr. Gray, that a new plant will be built soon. About 15,000 feet of cable are now being installed. The company operates a Sterling 2000-drop board and has 1971 subscribers.

LOUISVILLE, KY.—The Louisville Home Telephone Company, of Louisville, has been incorporated; capital, $1,000,000.

EMINENCE, KY.—The Eminence City Council has ordered sold a franchise for the establishment of a telephone system in this city at not less than $50 per year for twenty years.

MAYSVILLE, KY.—The Maysville Telephone Company has just been given a franchise and will begin at once to extend lines throughout the county in every direction. Connection with Aberdeen, Ohio, will be secured by cable laid across the river, and meeting the Independent Long Distance Telephone Company at that place from Portsmouth, Ohio.

DONALDSONVILLE, LA.—The American Telephone Company has applied for a franchise to construct and operate a telephone and telegraph system.

HAGERSTOWN, MD.—The Chesapeake & Potomac Telephone Company is constructing a line from this city to a point near Middletown, in Frederick County, to connect with the main line of its system.

DENTON, MD.—The Maryland & Delaware Telegraph & Telephone Company, of Wicomico County, has been incorporated; capital stock, $100,000. Directors: John Walter Smith, Walter B. Miller, Thomas H. Bock, Harry A. Richardson, Wm. H. Baker, Dupont Walker and Fred. R. Owens.

BALTIMORE, MD.—The Faller Automatic Telephone Exchange Company has been chartered to manufacture automatic telephone exchange appliances. The capital is $5,000,000. Ernest A. Faller, the inventor, is secertary of the company. A description of this system was published in last issue.

WINTHROP, MASS.—The Suburban Telephone Company has been incorporated, with a capital stock of $30,000.

MENOMINEE, MICH.—The Green Bay & Lake Michigan Telephone Company was given a franchise by the City Council to construct lines in Menominee.

HATTIESBURG, MISS.—The People's Telephone Company, capital stock $20,000, has been incorporated by A. U. Montgomery, T. E. Ross, W. A. Dozier and others.

AMORY, MISS.—The Amory & Tupelo Telephone Company operates Sumter apparatus, a 110-drop board, with 103 subscribers. Toll lines have recently been constructed and more are projected. Mr. Camp, general manager, reports business prosperous.

BOSWORTH, MO.—The Bosworth Telephone Company, capital stock $4,000, has been incorporated by W. J. Williams, W. S. Windsor, G. L. Reavis and others.

SEA ISLE CITY, N. J.—The lines of the Delaware & Atlantic Telephone Company are being extended to Corson's and Townsend's Inlets.

JERSEY CITY, N. J.—The reorganization of the Hudson Telephone Company has been followed by the announcement that the reorganized company intends to try once more to spread out and to extend its lines in all directions. Wm. J. Foster, of New York, is interested.

CORTLAND, N. Y.—The Cortland Home Telephone Company operates Stromberg-Carlson apparatus, a 700-drop board, not including toll lines, of which there are 100 miles with 26 stations. There are 670 subscribers and good prospects of increase.

ROME, N. Y.—It is the intention of the Rome Home Telephone Company to make an application to the Utica Common Council in the near future for a franchise to extend its lines to that city. Some years ago the Mohawk Valley Telephone Company obtained a franchise in Utica, but it has not yet made use of it.

RAY, OHIO.—The Ray & Vigo Telephone Company, capital stock $5,000, has been incorporated.

PORTSMOUTH, OHIO.—The Portsmouth Telephone Company has completed a new line from Portsmouth to Gallipolis.

SPRINGFIELD, OHIO.—The Springfield Board of Public Affairs has granted permission to the Springfield Home Telephone Company to lay conduits.

FREMONT, OHIO.—The Fremont Home Telephone Company has established a new exchange at Lindsey. Business in that section of Sandusky County is growing rapidly.

ADDISON, OHIO.—The Addison Telephone Company, of Addison, has been organized, with Frank Vanden, president; Asa Bradbury, secretary, and T. J. Daniels, treasurer.

XENIA, OHIO.—The Miami Telephone Company will shortly build a direct line from Xenia to Washington, C. H., by way of Jamestown and another to Wilmington by way of the Burlington Pike.

STEUBENVILLE, OHIO.—The Phœnix Telephone Company has received a number of new instruments which are to be installed on its lines in Steubenville. The business of the company is growing very rapidly.

ATHENS, OHIO.—The Irvin Valley Telephone Company has been incorporated by S. Woodyard, J. F. Carbaugh, Thomas Towsley, L. Jeffers and C. C. Johnson. The company will build lines in southern Athens and northern Meigs counties.

COSHOCTON, OHIO.—The Coshocton Telephone Company has received a large shipment of telephone instruments which have been delayed for some time. They are being installed and the system will be placed in operation as soon as possible.

DELAWARE, OHIO.—A temporary injunction has been secured by the United States Telephone Company and the Sunbury & Galena Telephone Company against the Central Union Telephone Company restraining it from erecting poles and stringing wires in the town of Sunbury.

PORTSMOUTH, OHIO.—Mr. Thomas Numan, manager of the Portsmouth Telephone Company, has been appointed manager of the United States Telephone Company for seven counties, including Scioto, Jackson and Lawrence, in Ohio, and Ohio, Lewis and Greenup in Kentucky.

WARREN, OHIO.—A. B. Conklin, heretofore superintendent of construction of the Warren & Niles Telephone Company, of Warren, has been elected treasurer of the Interstate Independent Telephone & Telegraph Company, which has recently been organized to build and acquire exchanges in Illinois.

ST. CLAIRESVILLE, OHIO.—The Belmont Telephone Company, of Belmont County, is to be consolidated with the National Telephone Company of Wheeling, W. Va. The Belmont Company has been an independent company operating exchanges and toll lines at Bridgeport, Martin's Ferry, St. Clairesville, Barnesville and Bellaire.

MASSILLON, OHIO.—The United States Telephone Company has established in Massillon a division headquarters. Edward E. Ebersole, of Cleveland, has been appointed Superintendent of Maintenance of Way, and C. W. Sebern, assistant superintendent. Both will be located in Massillon. A fifty-wire test station will be located here.

CHAGRIN FALLS, OHIO.—To further complete the independent lines in Geauga and neighboring counties, the Newbury Telephone Company, of Newbury has been incorporated with $10,000 capital stock, by George W. Stafford, C. H. Hubbell, W. D. Brewster, F. P. Schumacher, J. M. Hutchinson and Leon S. Hubbell. The company will be affiliated with the Geauga County Telephone Association.

CANTON, OHIO.—George S. Walton, general manager of the Stark County Telephone Company, with headquarters at Canton, has resigned, and will be succeeded by A. A. Hillstock, formerly manager of the Central Union Company's exchange at Washington, C. H. Mr. Walton was formerly secretary of the Columbiana County Telephone Company, and later assistant counsel for the Federal Telephone Company.

CINCINNATI, OHIO.—Corporation Counsel Hunt of Cincinnati, has attacked the validity of the transfer by the Fitzimmons Telephone Manufacturing Company of the use of the streets to erect poles, string wires, etc. It is claimed that the franchise is not transferable. The Fitzimmons Company is an independent company which holds a franchise in Cincinnati and which has been endeavoring for some time to build an extensive system in that city.

CLEVELAND, OHIO.—The local telephone companies are making veiled threats that if the City Council passes the Beilstein ordinance which was introduced some time ago, extending the underground district to the outlaying parts of the city, that they will simply remove their lines from certain parts of the city and permit public indignation to settle the matter. It is claimed that in some parts of the city it would cost more to place the wires under ground than could be secured from rentals in a number of years. The ordinance is now before a committee. The companies have agreed to frame an ordinance showing what they are willing to do in the way of extending the underground district.

CLEVELAND, OHIO.—Cleveland people who are interested in the Springfield Home Telephone Company report that construction work is being pushed very rapidly, 150 men being employed at the present time. Solicitors have been at work sixty-five days, and thus far have secured 1112 contracts. It is expected that the plant will be in operation early next spring. The company will shortly be consolidated with plants at Xenia, Jamestown and Yellow Springs in Greene County. The consolidated company will be known as the Springfield-Xenia Telephone Company and will have a capital stock of $500,000. The officers of the new company will be as follows: N. J. Dreyfoos, president; J. M. Blatt, secretary, and L. M. Wolf, treasurer, all of Cleveland.

CANTON, OHIO.—The Business Men's Association, of Canton, a few evenings ago held a joint meeting with the Grocers' Association and the Butchers' Association and adopted resolutions agreeing to cancel their contracts with the Central Union Telephone Company rather than pay the advance in rate from $42 to $54 per year which the company has announced. George Holmes, manager of the Bell Company, claimed that no decision to increase the rates had been decided upon, but it was proven among those present at the meeting that the advance had been asked by solicitors. The advance is looked upon as a queer move in view of the fact that the exchange of the Stark County Telephone Company is shortly to be opened with low rates, improved apparatus and long distance service.

NEW CASTLE, PA.—A local telephone service is being established in New Wilmington.

CONNEAUTVILLE, PA.—Mr. Corry, secretary of the Conneautville Telephone Company, informs us of the steady growth and bright prospects of his company. It uses Stromberg-Carlson apparatus and has a 150-drop board, besides a long-distance board, having connection through the Union Telephone & Telegraph Company's lines. The company has over 300 miles of wire in use.

ORANGEBURG, S. C.—The Orangeburg & St. Matthews' Telephone Company, incorporated lately, has its system in operation and has long-distance connections.

CALDWELL, TEX.—The Trans-Texas Telephone Company has just started business. It has a 100-drop switchboard and 75 subscribers, with 75 miles of toll line. Another exchange at Somerville with 50 telephones is projected.

SALT LAKE CITY, UTAH.—The Salt Lake Home Telephone Company, through Attorney Elmer B. Jones, Samuel F. Fenton and P. T. Madsen, its promoters, intends to go before the City Council Committee in relation to its petition for a franchise to build and conduct an independent system in this city.

GRAND ISLE, VT.—A new telephone company has been organized at this place, to be called the Grand Isle Telephone Company; capital stock, $2,000. The directors are Albert Kinney, Juan Robinson, Joseph Angel, and Dr. F. W. Sears.

SUNNYSIDE, WASH.—The Christian Co-operative Telephone Association uses Eureka apparatus, has a 100-drop board and 32 subscribers.

ELECTRIC LIGHT AND POWER.

ARKADELPHIA, ARK.—Articles of incorporation of the Wilson Water & Electric Company, of Arkadelphia, have been filed. The capital stock is $75,000, all of which has been subscribed. The officers are: J. W. Wilson, president and treasurer; J. H. Crawford, vice-president; Josiah Hardage, secretary.

SAN FRANCISCO, CALIF.—An electric lighting plant is installed in Mendocino, Calif., and buildings are being wired for electric lights.

SAN FRANCISCO, CALIF.—The Richmond Light & Water Company has been incorporated, with San Francisco as the principal place of business. Directors: H. Disque, F. M. Ferguson, F. A. Edinger, W. P. Pringle and C. C. Juster. Capital stock, $25,000; subscribed, $410.

SAN FRANCISCO, CALIF.—An electric power plant will be installed by the Boston company, which controls the Trinity and Arcadia group of mines near Lovelock, Nev. The mining works will be operated and lighted by electricity transmitted from the new power station.

HAYWARDS, CALIF.—The Town Trustees of Haywards, have decided to call on election for the voting of $15,000 in bonds for the purpose of establishing a municipal electric lighting plant. The amount to be spent for the plant is $12,000 and the balance for the buildings.

LOS ANGELES, CALIF.—The Salinas Water, Light & Power Company was recently incorporated, with Los Angeles as the principal place of business. Directors: O. Z. Hubbell, J. H. Gardner, R. C. P. Smith, F. J. Whiffen and C. W. Allen. Capital stock, $200,000; subscribed in full.

SAN FRANCISCO, CALIF.—The Joint Supervisors Committee on Judiciary and Public Utilities, at a recent meeting in San Francisco, agreed upon plans for the proposed ordinances authorizing special elections for the purpose of issuing bonds for the acquisition of Public Utilities, including lighting.

SAN FRANCISCO, CALIF.—One of the latest California power transmission projects is that in which Chas. D. Lane, the steamship and mining capitalist, and A. B. Thompson, of Angels, are interested. The company controls water rights and purposes to construct a 35-mile water ditch from the headwaters of the middle fork of the Stanislaus River, which will convey the water to Murphys, Vallecito and Angels.

SAN FRANCISCO, CALIF.—The main electric generating plant of the Kern Power Company, recently incorporated will be located near Kernville, where the water rights have been acquired. It is proposed to transmit electric power over a large part of Southern and Central California and to Los Angeles. It is said it will take about two years to place the new system in complete operation. The Los Angeles Railway Company's officials are largely interested in the project.

SAN FRANCISCO, CALIF.—The Calaveras Mining, Power & Water Company, composed of San Francisco and Oakland capitalists, has completed a large amount of hydraulic engineering work in connection with its mining and power projects. Water is taken from the headwaters of San Antonio Creek, near the Big Trees. The company proposes to build two dams next summer, which will give a capacity of 500 miner's inches of water day and night for two years. It is asserted that electric power can be profitably transmitted to San Francisco from the proposed generating plant.

RIDGE FARM, ILL.—The Ridge Farm Electric Light, Heat & Power Company, Ridge Farm, Ill., has certified to an increase of capital stock from $5,000 to $10,000.

LINCOLN, ILL.—The Lincoln Heat, Light & Water Company, of Lincoln, Ill., has been incorporated, with a capital stock of $50,000. The incorporators are W. A. Thomas, James W. Collins and David H. Harts.

BLUE MOUND, MO.—An election will be held on the question of purchasing the electric light plant.

OTTAWA, OHIO.—Citizens of Ottawa are agitating a proposition to build a municipal electric lighting plant in connection with the water works.

STEUBENVILLE, OHIO.—The Steubenville Council is considering a proposition to bond the town for $40,000 for the purpose of building a municipal lighting plant.

KENTON, OHIO.—Contracts are being let for the equipment of a large brewery to be erected here by Peter Waldeck. Electrical and refrigerating machinery will be required.

CANTON, OHIO.—The Central Heat & Power Company has been granted a franchise to erect a steam heating and electric power plant in Canton. Ed. L. Smith is at the head of the project.

UPPER SANDUSKY, OHIO.—H. E. Hill and J. M. Barber, of Marion, have applied for a franchise in Upper Sandusky to build a steam heating and electric power plant. The franchise will be granted.

OTTAWA, ONT.—The plans of the proposed works of the the Ontario Power Company at Niagara, for the development of 150,000 electric horse-power will be filed here. The company will commence operations shortly, and will at first install machinery for the development of 50,000 horse-power. It will develop power at Chippewa, close to the point where the Welland River enters the Niagara River, and the works will give a head of 270 feet. The company expects to find in Canada a market for the power it proposes to develop.

SALT LAKE CITY, UTAH.—Negotiations are pending between the Utah Light & Power Company and the Consolidated Railway & Power Company with the view to avoiding the expenditure by the latter of $300,000 for a new steam power plant. If they are carried through additional power will have to be provided for in planning the proposed new dam and reservoir in Ogden Canon of the Utah Light & Power Company for the use of the railway company.

SALT LAKE CITY, UTAH.—Col. Altman and A. B. Lewis will build a large power plant on the banks of the Beaver River, using its waters for power. It is the intention of the company to furnish light and power to the surrounding country; also power to the various mining companies operating in and around Milford and Frisco. In addition to this these gentlemen propose to build an electric railway between Beaver City and Milford, connected by a stage line.

THE ELECTRIC RAILWAY.

FT. WAYNE, IND.—The Ohio & Indiana Air Line Railway Company, a recent consolidation of the Ohio & Indiana and the Toledo-Bryan companies, announces having secured right of way for the entire 157 miles between Toledo, Ohio, and Marion, Ind. It will use the Bonner rail wagon for the transportation of farm products to the market terminals without reloading.

LEXINGTON, KY.—The Bluegrass Traction Company, a $7,000,000 interurban electric railway syndicate, has opened temporary offices in Lexington, with Harold C. Beatty, of Detroit, in charge, representing New York, Chicago and Detroit interests.

CHARLOTTE N. C.—W. H. Moore, president of the National Good Roads Association, has made a proposition to the citizens of Greenville and Tusculum, Tenn., to build an electric railway between the two points, four miles apart. The proposition, it is said, has virtually been accepted.

CHARLOTTE, N. C.—The Cumming & Buford Electric Railway Company has been chartered to construct a sixteen-mile line between the above two points in Georgia. The capital stock is $500,000. The incorporators are J. G. Puett, R. W. Shadburn, H. L. Patterson and John H. Hockehull, of Cumming, Ga., and H. D. Jaquish, W. Thompson, Chas. H. Smith, Jr., R. J. Owens and J. O. H. Brown of Buford, Ga.

ALBANY, N. Y.—The Hudson Valley Railway Company has filed a certificate of a change in its route so as to take in Round Lake. This is the trolley line running between Albany and Lake George.

ALBANY, N. Y.—The Interurban Street Railway Company, as a reorganization of the North Mount Vernon Railway Company, has been incorporated with a capital of $500,000. The directors are Andrew A. Halsey, Fred. C. Cocheu, Joseph F. Coffey, Charles M. Sweeney, Joseph F. McClean, Michael J. Kennedy, Louis H. Meht, George W. Seixas and William J. Studwell, of Brooklyn.

MADISONVILLE, OHIO.—The Cincinnati & Columbus Traction Company has applied for a franchise through Madisonville.

FREMONT, OHIO.—Kerlin Brothers, owners of the Fremont & Ballville Street Railway, are building a temporary water power plant at Ballville.

GARRETTSVILLE, OHIO.—Citizens of Garrettsville are endeavoring to induce the Northern Ohio Traction Company to extend its Ravenna line to Garrettsville.

DAYTON, OHIO.—An ordinance has been passed by the City Council of Dayton granting franchises to the People's Railway Company to build extensions to several of its lines.

TOLEDO, OHIO.—The passenger earnings of the Toledo Railways & Light Company for November were $77,514.14, a gain of $6,968.66. The receipts from lighting will amount to about $25,000.

CLEVELAND, OHIO.—The Springfield & Xenia Traction Company has authorized an issue of $500,000 in bonds. The road is being built between Springfield and Xenia and is nearly completed.

MANSFIELD, OHIO.—The Vermillion, Mansfield & Southern Railway Company has been incorporated with $10,000 capital by E. J. Coen, George Fisher, R. F. Quigley, C. C. Baumhart and Charles McGraw.

TOLEDO, OHIO.—The Toledo Railways & Light Company is considering a number of extensions and improvements. Specifications will be furnished by C. W. Wason, purchasing agent for the Everett-Moore syndicate at Cleveland.

COLUMBUS, OHIO.—The Central Ohio Traction Company, which proposes to build a line from Columbus to Wheeling, W. Va., has increased its capital stock from $100,000 to $600,000. R. S. Vivian is president and James D. McDowell, secretary.

CLEVELAND, OHIO.—The passenger earnings of the Cleveland Electric Railway Company for the month of November were $188,642.71, a gain of $16,108.34. Eleven months, $2,094,556.91, a gain of $220,705.97 over the same period last year.

UPPER SANDUSKY, OHIO.—O. C. Stutz, promoter of the line which is to be built from Tiffin to Upper Sandusky, has applied to the citizens of Upper Sandusky for a site for power-house and car barns. The company is to be incorporated within a few days.

DAYTON, OHIO.—The Ft. Wayne, Dayton & Cincinnati Traction Company will shortly increase its capital stock from $1,000,000 to $5,000,000. The company is incorporated under the laws of South Dakota and proposes to build 350 miles of road in Indiana and Ohio.

TOLEDO, OHIO.—President Lang, of the Toledo Railways & Light Company, states that from $400,000 to $500,000 will be spent on the Toledo lines during the next few months. A large addition will be built to the power house, extensions will be made and new cars purchased.

AKRON, OHIO.—The power house at Akron will be enlarged to take care of the Canton-Akron extension of the Northern Ohio Traction Company, and the original plan of building a power-house at New Berlin will not be carried out. A sub-station will probably be established at Canton to take care of that portion of the line.

SPRINGFIELD, OHIO.—Officials of the American Railways Company, Philadelphia, held a conference recently with the manager of the Springfield Railway Company relative to improvements to be made to the Springfield lines. The power houses of the railway company and the Springfield Light & Power Company are to be consolidated. New cars are to be purchased and new rails laid.

AKRON, OHIO.—Plans are being prepared for extensive additions to the power house of the Northern Ohio Traction Company. It is the intention to abandon the present stations at Bedford, Cuyahoga Falls, and Barberton and operate the entire system from one station. Early next spring the company will commence work on an extension from Barberton to Wadsworth by way of Western Star.

TOLEDO, OHIO.—The Toledo & Western Railway has completed a temporary bridge over the Lake Shore Railway at Adrian, Mich., and cars will be operated through from Toledo to Adrian within a few days. A new 1000-hp generating unit has just been placed in operation at the Sylvania power house and another is being installed. When completed the power-house will have a capacity of 3000 horse-power, sufficient to operate both the Ohio and Michigan divisions of the road.

CLEVELAND, OHIO.—The Pomeroy-Mandelbaum syndicate has acquired and consolidated the Tuscarawas Electric Company and the Tuscarawas Railroad Company. The new company will be known as the Tuscarawas Traction Company, and will have a capital stock of $350,000 and will issue bonds for the same amount. Officers have been elected as follows: F. T. Pomeroy, president; J. A. Reutherford, Canal Dover, vice-president; J. O. Wilson, Cleveland, secretary, and W. A. Akins, New Philadelphia, treasurer and general manager. Lines are in operation from Canal Dover to New Philadelphia and from New Philadelphia to Uhrichsville. The former line will be extended from Canal Dover to Strasburg, giving the system 20 miles of road.

NASHVILLE, TENN.—It is said that prospects are good for the building of an electric railway from Adamsville, Ky., via Springfield, Tenn., to Nashville. People along the route are enthusiastic over the matter.

YORKTOWN, VA.—The charter members of the Yorktown, Pequosin & Hampton Electric Railway at a meeting at Yorktown have disposed of their rights to a new company headed by O. D. Jackson, of Norfolk, Va. Fifteen thousand dollars has been subscribed towards building the line. The same company has secured the charter of a proposed line between Jamestown and Yorktown, Va. The big 500-hp electric plant at Ivy, N. C., has been started up and power will be transmitted to Asheville, 15 miles distant.

NEW INDUSTRIAL COMPANIES.

THE UNIVERSAL STEAM POWER COMPANY, of New York City, has been incorporated; capital, $100,000. Directors: W. J. Foster, Melvin Seabury, and W. B. Overton, of New York City.

THE STRATTON MOTOR COMPANY, of New York City, has been incorporated; capital, $150,000. Directors: E. F. Stratton and David Wood, of New York City, and G. H. Murray, Jr., of Hollis, L. I.

THE NEWFANE ELECTRIC COMPANY, of Newfane, Niagara County, N. Y., has been incorporated; capital, $1,000. Directors: C. T. Raymond and J. H. Eilers, of Lockport, and Joseph Robinson, of Newfane.

THE PROMETHEUS ELECTRIC COMPANY, of New York City, has been incorporated, with a capital of $500,000. The directors are B. T. Lynch, of Brooklyn, and S. G. Stewart and George Russell, of New York City.

THE UNION ELECTRICAL SUPPLY COMPANY, of New York City, has been incorporated; capital, $10,000. Directors: E. E. Westervelt and A. F. Westervelt, of Hackensack, and G. M. Johnson, of New York City.

THE EL RENO PLUMBING AND ELECTRICAL SUPPLY COMPANY, of El Reno, Okla., has been incorporated, with a capital stock of $3,000. The incorporators are: M. F. Pettie, S. B. Pettie, H. B. Hazelton, F. D. Johnson and J. B. Royalty, all of El Reno, Okla.

THE AMERICAN DIESEL ENGINE COMPANY, of New York City, has been incorporated; capital, $2,500,000. Directors: Alfred L. Curtiss, Mark Hyman, D. W. Morrow, Nathan A. Smyth, Graham Sumner, Harold Walker, of New York City, and J. Clinton Walker of Brooklyn.

LEGAL.

CONSOLIDATED REFRIGERATING.—The New York Law Journal says that in the action brought by H. W. Rosenbaum on behalf of the minority stockholders of the Consolidated Equipment Company against Isaac L. Rice, the Consolidated Refrigerating Company and others, Justice Leventritt has just handed down a decision in favor of Mr. Rosenbaum and denying Mr. Rice's and the other defendants' motion to vacate an order obtained for their examination before trial and production of books, etc., for the purpose of obtaining a full disclosure as to all of the details and facts surrounding the deal put through last spring. Justice Leventritt in his decision states that if Mr. Rosenbaum can establish the allegations set forth in his pleadings he will be clearly entitled to success upon the trial.

TELEPHONE SWITCHBOARD SUIT.—The case of the Western Electric Company against the Kinloch Telephone Company, St. Louis, came before the Federal Court of Appeals in St. Louis last week. The suit was an appeal from a decision of the Circuit Court, in which an injunction was granted last summer restraining the Kinloch people from using a certain switchboard. The Western Electric Company claims that this switchboard is an infringement of a patent which it owns. The Kinloch Company denies the validity of the patent. After the injunction by the Circuit Court a stay was granted until after the Court of Appeals shall have decided the question. The arguments were concluded and the question submitted. Another suit in which the same companies are concerned came up the day following. This relates to a lightning arrester, on which the Western Electric Company claims that the Kinloch Company has also infringed.

A TELEPHONE SUIT.—At Birmingham, N. Y., recently, the Consolidated Telephone Company, of Cleveland, won an important point in a suit which was brought against it some time ago by the Bell Company. The suit was originally brought in the Supreme Court at Elmira. The Bell Company sought to restrain the independent company from building a pole line up through its lines, where, because of the character of the highway, it was shown to be necessary. Both companies held a franchise over the highway, but the Bell Company claimed that by right of priority it held the exclusive right along the line where its poles had been erected. The first court granted a temporary restraining

order, but the Consolidated Company secured a reversal of this decision because the suit had been brought without notice. The Bell Company then gave notice and filed another suit. This hearing was held in Birmingham recently and the court declined to grant a temporary injunction, so that the case will be heard later on its merits.

OBITUARY.

E. J. MATHEWS, president of the American District Telegraph Company, of Philadelphia, was killed last week by a fall from his horse. He was born in Philadelphia in 1836. For many years he was in the brokerage business there, but some time ago came to New York, where he was associated at 40 Wall Street with his son, Wilbur, under the title of E. J. Mathews & Company. Mr. Mathews had been prominent in street railway affairs in Philadelphia, and at one time was heavily interested in Metropolitan Street Railway. He was also the prime factor in the New York & Queens County Railway, a director of the Postal Telegraph Company, and had been recently appointed a Commissioner of the State Reservation at Valley Forge. He leaves a widow, a daughter and three sons.

THOMAS DICKENSON BOYLES died in Schenectady, N. Y., on Saturday, Nov. 30, after a brief but severe and painful illness. Born in 1870, his entire education was directed towards the engineering profession. Graduating from the Rose Polytechnic School at Terre Haute in the class of '92, he took up the profession of electrical engineering immediately. A natural leader, Mr. Boyles was prominent in his alma mater, and there are few Rose men of the last decade to whom his name is not familiar as synonomous of all that a college man should be. Mr. Boyles entered the employ of the General Electric Company in 1892. His early work was chiefly devoted in the street railway department, and more particularly in connection with controller design. Early in his professional career he began to give much attention to the art of switchboard design. This class of engineering proved to be particularly attractive to him, and with switchboard design and construction, and the design of devices for switchboard use Mr. Boyles speedily identified himself as a specialist. Entering this branch of the electrical art at a period when it first demanded close and detailed study, and at a time when the character of electric service and transmission was rapidly changing to higher potentials and to larger units, Mr. Boyles' work speedily brought him into prominence, and to all who have made a study of switchboard engineering during the past five years his name is familiar. In 1899 Mr. Boyles abandoned pure engineering to enter the commercial department of the General Electric Company in connection with the switchboard office, and to his zealous efforts are quite largely due the present character of that organization. Mr. Boyles was associated with substantially all of the great switchboard problems of the last five years; notably, the Metropolitan and Manhattan projects, important portions of the Niagara Falls equipment, and the large and important boards of the New York Gas & Electric Company and of the Boston Edison Company. Indelible as is the mark which Mr. Boyles' personality and ability has left upon the profession of electrical engineering, he will be remembered yet longer and more tenderly for the splendid qualities of gentle manhood which endeared him to all of those with whom he came in contact. Amongst those to whom he had given friendship—and he gave it freely wherever it was deserved—the loss of his cheerful presence and helpful counsel must always be beyond remedy and beyond replacement.

PERSONAL.

MR. W. F. D. CRANE has joined the engineering force of Sanderson & Porter, 31 Nassau Street, New York City, the well known consulting and contracting engineers.

SIR C. FURNESS, the English shipbuilder and ironmaster, who is largely interested in London underground roads, has just returned to England, after a long visit on this side.

PROF. W. L. PUFFER, of the Massachusetts Institute of Technology, has recently returned from a trip to Europe, where he has been studying more particularly the nature of the education given there in electricity.

MR. JOHN JACOB ASTOR, who has long been interested in electric launches, has applied for United States and foreign patents on a new type of marine turbine engine, which has the shaft and the casing revolving in opposite directions.

MR. J. G. WHITE, head of the London and New York engineering firm that bears his name, has, we regret to say, been quite ill lately. His early and complete restoration to health is looked for, much to the delight of a host of friends on both sides of the Atlantic.

COL. R. C. CLOWRY, general superintendent of the Western Union Telegraph Company, was lucky in escaping without injury last week from a train wreck near The Dalles on Dec. 6 in Oregon. His special car stayed on the track while several others left it. The "accident" is attributed to train wreckers.

MR. CLARENCE P. DAY announces in a circular his retirement from the vice-presidency of the Industrial Press and his entry into the advertising field as an advertising counsellor. The capacity in which he proposes to act is that of counsellor to the advertiser in regard to mediums of a mechanical or technical character. Mr. Day's long experience in the field should make him of value to any one needing his services.

MR. DAVID YOUNG has decided to resign as president of the Elizabeth, Plainfield & Central New Jersey Street Railway Company, in order to give all his time to the presidency of the Jersey City, Hoboken & Paterson Street Railway Company, and vice-presidency of the North Jersey Street Railway Company. For a year he has looked after three separate trolley systems, but the work is too much, and Mr. Alfred Barr will take charge of the Elizabeth and Plainfield system. Mr. Barr was until recently connected with the Worcester, Mass., traction lines.

MR. LOUIS R. ALBERGER, recently with the Henry R. Worthington Company, has formed the Alberger Condenser Company, of which he is president, the other officers being George Q. Palmer, of the Quintard Iron Works, and Messrs. B. W. Pierson, D. H. Chester and George P. Symonds, recently with the Worthington Company. The company will manufacture and sell condensing apparatus, vacuum pumping machinery and cooling towers, embodying important improvements, and will make a specialty of steam pumping and condensing apparatus for electric lighting and railway power stations.

MR. E. R. KNOWLES, of New York City, has been retained by the United States Government as consulting engineer for the electrical equipment of the gantry crane at Sandy Hook proving grounds. He has also been retained as consulting engineer by Mr. E. W. Bliss for the new ten-story factory building and the remodeling and equipping with electric power of five other factory buildings, all situated on 22d and 23d streets and Second Avenue, New York. A power plant of sufficient capacity will be installed in the new building, and from this point it and all the other buildings will be operated.

COL. JOHN PARTRIDGE, the present New York State Commissioner of Public Works, and now selected by Mayor Low as the next Police Commissioner for Greater New York, is well known to electrical people. He served for ten years or more as President of the Brooklyn & Newtown Railroad Company, since consolidated with the Coney Island & Brooklyn Railway Company. During the trolley strike of 1895, when every line in Brooklyn was tied up, Col. Partridge spent three days and nights conferring with the men employed on the cars of his company, and made concessions which enabled him to open his lines to the public at the end of that time. All of the other companies operating in the city held out against their employes, and in consequence most of the people of Brooklyn had to walk for three weeks of the winter.

MR. JOSEF HOFMANN, the famous young pianist, who is now in New York, is very fond of mechanics and quite an inventor in gasoline automobiles, etc. He would also appear to be working on storage batteries, although we do not follow easily this account from the *New York Herald:* "One of the methods of regenerating or recharging, chemically, such electrodes heretofore attempted to be used, has been by the employment of the hypochlorites, such as chloride of lime. That was disadvantageous, because during the oxidation of the electrode a deposit was formed, which had a bad effect, increasing the internal resistance of the battery, so that the electro-motive force would rapidly diminish. Mr. Hofmann has overcome these difficulties, and has demonstrated that the accumulator electrodes can be regenerated by chemical means, and in a practically feasible way, by the use of free hypochlorous acid in solution, instead of the troublesome hypochlorites. This invention may seem simple, but the simplest inventions are generally the most important and valuable."

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is calling attention to its special five magnet generator type, No. 36 telephone, for heavily loaded or poorly constructed farmers' lines. It claims that they will ring through anything.

LINOTYPE MOTOR.—Bulletin No. 163 of the Jenney Electric Manufacturing Company, Indianapolis, Ind., describes and illustrates the Jenney linotype motor. The advantages of these machines are pointed out, and their construction is clearly illustrated.

REMOVAL.—The Gordon Battery Company announces that it has secured larger quarters at 439-445 East 144th Street, New York, which it will occupy on and after Jan. 1 next. This will enable the company to handle its increasing business with greater dispatch.

CROSS OIL FILTERS.—Two very large Cross oil filters were recently shipped to Smyrna, Asia Minor, by the Burt Manufacturing Company, of Akron, Ohio. The sale of this filter has extended to twenty-eight different countries, which is good evidence of its merits.

VOLTMETERS AND AMMETERS.—The Federal Instrument Company, 82 State Street, Albany N. Y., has issued a price list of its voltmeters and ammeters for direct and alternating current circuits. The instruments are illustrated and briefly described. They are claimed to be of the highest grade.

ELECTRIC LIGHT SUPPLIES.—The Central Electric Company's stock of sleet-proof pulleys, iron brackets, windlasses, street hoods, arc lamp cordage, etc., is very large and complete. The season for installing this material is now at hand, and this company will quote prices by return mail, and make prompt shipments in order that customers may be supplied before the severe winter sets in.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, is sending out a small pamphlet illustrating some very new and novel ideas in electric heating apparatus. It illustrates an electric heater which is entirely new, for use in houses or cold corners of offices, etc. It states that the current consumption of these heaters is very small and they can be operated at nominal cost. They are rapidly superseding gas stoves, grate fires, etc., in various places, are much more cleanly, and can be easily regulated.

THE ELECTROGRAPH.—The Electrograph Company of America, which was recently organized to exploit the electrograph (a machine for transmitting pictures by wire) has just issued its prospectus. The Electrograph and its operation are described, and illustrations show the machine and reproductions of its work. This machine was described and illustrated in ELECTRICAL WORLD AND ENGINEER of April 13 last, and was exhibited at the conversazione of the American Institute of Electrical Engineers at Columbia University in the same month.

THE LIBERTY MANUFACTURING COMPANY, 5988 Centre Avenue, Pittsburg, is the successor to the Chicago Boiler Cleaner Company, which formerly did business at the same address. The new company will continue to manufacture the Chicago boiler cleaner and the famous oil filter and purifier. Some very marked improvements are being made in the cleaner in the consumption of water, increase of power, and durability. Mr. G. W. Atterbury, the

president of the new company, is now in Europe establishing agencies made necessary by the rapidly increasing foreign business of the company.

THE ONONDAGA DYNAMO COMPANY, Syracuse, N. Y., has recently been surprising its friends with a second issue of its famous "Infernal" circular. The startling feature of this literature is a "buzzer" which "goes off" with considerable noise when the recipient opens up the paper. This centers attention on the contents of the circular, which describes and handsomely illustrates the company's fine line of dynamos and motors and the application of some of the latter to the running of machine tools, etc.; the man who gets the "shock" from the "buzzer" in this new circular is pleased to find that the make-up of the thing includes a key ring which he may detach and use.

"THE LIVING AGE" has printed as usual Prince Krapotkin's excellent review of current science. Two travel papers, quite different in their subjects, but suggesting comparison by the brilliancy of their style, are Arnold Haultain's description of "A Winter's Walk in Canada" in *The Living Age* for Nov. 23, and Harold Spender's "Ravenna" in the same magazine for Nov. 30. They are both of a quality too seldom seen in American magazines. The *National Review's* important article on the Foreign Policy of England, which has set both the English and the Continental press to talking of the possibility of an understanding between England and Russia, will be reprinted without abridgment in the *Age* for Dec. 14.

MR. W. DRUMMOND MARROW, formerly of Richmond, Va., who was general manager for the Standard Electric Company, of Danville, Va., from its organization in March last, has severed his connection with it to enter for himself the consulting electrical engineering, construction and repair business at 233 South Tryon Street, Charlotte, N. C. This was the former office of the Standard Electric Company, which Mr. Marrow fitted up while in the company's employ, and purchased from it, when he severed his connection with that concern. Mr. Marrow has had about sixteen years' experience in the different electric branches, having been in business for himself until March last, for the past ten years. He proposes to represent manufacturers of every description in that part of the country.

THE CENTURY TELEPHONE CONSTRUCTION COMPANY, of Cleveland, is making additions to its floor space and factory equipment which will give it largely increased facilities for turning out telephone switchboards and other apparatus. At present the company's factory is crowded with work. Among other boards under construction are three 1000 central energy boards for the exchanges in New York, of the Consolidated Telephone Company, with which the Century Company is affiliated. The company is working on a new long distance transmitter and will soon have an important announcement to make relative to a number of new varieties of central energy apparatus now being experimented with. The company has just issued Bulletin No. 10 illustrating and describing several new lines of apparatus.

CABLE TESTING APPARATUS.—Mr. James G. Biddle, Stephen Girard Building, Philadelphia, has received orders for cable testing equipments from such prominent companies as the Bell Telephone Company of Philadelphia, Keystone Telephone Company, Philadelphia, Interstate Telephone Company, Trenton, N. J.; Reserve Construction Company, Cleveland, Ohio, and the Pittsburgh & Allegheny Telephone Company, Pittsburgh, Pa. All of these outfits included one or more of the Fisher cable testing sets, which have practically come to be considered as standard apparatus for this class of work. The Fisher sets are made by Leeds & Company, for whom Mr. Biddle is sole selling agent. By addressing him, interested parties can secure a copy of catalogue 360 without charge. It describes the Fisher sets in detail, as well as accessory apparatus.

THE HENRY ELECTRIC EQUIPMENT COMPANY, of Denver, Colo., recently noted in our Commercial Intelligence, has started business and opened offices at 417 Boston Building, that city, to exploit some of the later work of the inventor, Mr. J. C. Henry, who died this year. The first thing taken up is a train lighting system just tested. The Henry Electric Equipment Company, which is to manufacture these new appliances in Denver, is as follows: President, C. F. Elliott; secretary, D. Carl Henry; directors, William Barber, mining broker of Colorado Springs; James H. Peabody, president of the First National Bank of Canon City, and State Senator N. F. Handy, also of Canon City. Among the others who witnessed the test were O. H. Shoup, of the Reed Investment Company, Colorado Springs; A. A. Burnand, of the Small Hope Mining Company, Leadville; Asa Fisher, of the La Belle Water & Power Company, Goldfield, Colo.; N. H. Fraser, C. A. Kuck and Thomas E. Smith, all of Denver.

FIRE DETECTING WIRE.—At the convention of the Pennsylvania State Firemen, held Oct. 2 last, the committee on exhibits made a very flattering report on the exhibit of the Montauk Fire Detecting Wire Company, of New York, which report was ordered printed in the proceedings. As is well known, the Montauk fire detecting wire is a wire which is affected by dangerous heat as well as by the smallest flame (even that of a match) and gives an alarm in from ten to fifteen seconds; it is a continuous thermostat. It has the approval of the Fire Underwriters of the City of New York, and is being rapidly introduced, some of the recent installations covering millions of dollars' worth of property. It is as efficient as a burglar alarm and is of such a nature that it can be spliced to other wires where there is danger of fire. The wire does not reduce the fire hazard, but it does give a warning very quickly, and is a valuable adjunct to protection of life and property.

INCANDESCENT LAMPS.—Among the many incandescent lamp manufacturers who have recently come into prominence is the firm of Goodchild & Welsh, 275 and 277 Broome Street, Newark, N. J. This firm started in a very modest way about two years ago and has steadily increased until it is to-day one of the largest firms in the East in this line. Its new and well equipped factory, with the best up-to-date machinery that can be procured, enables it to produce an output of 1500 lamps per day. These lamps, it is stated, have given perfect satisfaction wherever used and duplicate orders are the result. The firm's customers include many of the largest lamp users in the country, and the Hahne department store in Newark, N. J., described and illustrated elsewhere in this issue, is fitted out exclusively with these lamps. This firm claims to use the best material, and skilled labor, and the testing is carefully done under the supervision of M. H. Welsh, who was for seven years with the General Electric Company.

THE HAINES & NOYES COMPANY, manufacturer of guaranteed telephone apparatus for every possible use, Chicago, announces the appointment of the following agencies: Gilson & Hatch, Lynn, Mass.; Geo. R. Mathieu, 6000 Hoevler Street, E. E. Pittsburg, Pa.; C. K. Hill, 201 Seventh Street, Pittsburg, Pa.; Roak & Rittenhouse, 723 Walnut Street, Philadelphia, Pa.; Federal Electric Company, export agents, New York City; Risley & Boniface, 109 S. New York Avenue, Atlantic City, N. J.; J. E. Henry & Company, Baltimore, Md.; H. I. Sackett, Builders' Exchange, Buffalo, N. Y.; J. A. Erner & Company, Permanent Building, Cleveland, Ohio; Porter Bros., Louisville, Ky.; W. T. Osborn & Company, Kansas City, Mo.; Overton Manufacturing & Engineering Company, Topeka, Kan.; Portland General Electric Company, Portland, Ore.; Woodill & Hulse Electric Company, Los Angeles, Calif.; the John M. Klein's Electrical Works, San Francisco, Calif.; Mr. Chas. W. Geib, Spokane, Wash.; Mr. T. W. Tuggle, Beaumont, Tex.; Mr. T. W. Rachford, Springfield, Ill.; Erickson Electrical Equipment Company, Boston, Mass.; H. P. Wood, Louisville, Ky.; James Clark, Jr., & Company, Louisville, Ky. It has made Messrs. E. M. Van Duzee, Jr., & Company, its agents for the Northwestern States, with headquarters in St. Paul, Minn., for all exchange business.

A CHRISTMAS GIFT.—A new departure in Christmas gifts along educational lines emanates from Boston. The plan affords an opportunity for an employer to present—at a nominal cost—to any deserving young ware-earner a scholarship in one or more of the following courses: mechanical, electrical, stationary, locomotive, textile or marine engineering; mechanical drawing; heating, ventilation and plumbing. An employer's good-will, expressed in the adoption of the above suggestion, would be of an exceedingly practical and valuable nature. The young man is thereby afforded an opportunity to further his education along technical lines, and so fit himself for a better paying position, and this is accomplished without loss of time from his present occupation. A more opportune time than Christmas, while the very atmosphere is filled with the gift idea, could not possibly be chosen. A unique feature of this scholarship plan lies in the fact that a reference library of engineering practice, comprising over 2800 quarto pages, bound in five handsome leather volumes, will be given outright to all December recipients of these scholarships. The books will be sent so as to reach their destination at Christmas time. Full information as to these scholarships, their cost, etc., may be obtained by addressing the American School of Correspondence (chartered by the Commonwealth of Massachusetts), Boston, Mass., U. S. A.

Record of Electrical Patents

UNITED STATES PATENTS, ISSUED DEC. 3, 1901.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, Times Bldg., New York.]

687,709. PRODUCTION OF CAUSTIC ALKALI AND HALOGEN GAS; C. E. Acker, Niagara Falls, N. Y. App. filed July 18, 1899. (See Current News and Notes.)

687,723. ELECTRIC MOTOR; D. P. Burdon, Jacksonville, Fla. App. filed July 26, 1901. The motor employs a number of alternately energized magnets acted upon by separate sources of electrical energy whereby one source is at rest while the other is in action, thus providing a machine especially applicable for use in connection with batteries.

687,727. MACHINE FOR STRINGING WIRES; F. B. Collins, Vasser, Mich. App. filed April 29, 1901. A traveler adapted to travel on one or two wires and readily pass over insulators on cross-arms and at the same time deliver a wire either upon the cross-arm over which it is traveling or to one beneath.

687,729. OSCILATING DEVICE FOR BRUSH HOLDERS FOR ELECTRICAL MACHINES; W. Cooper, Cincinnati, Ohio. App. filed April 9, 1900. The brushes are caused to travel slowly backward and forward over the surface of the commutator, so as to wear the surface uniformly.

687,766. TROLLEY FOR ELECTRIC RAILWAYS EMPLOYING OVERHEAD CONDUCTORS; W. F. Mack, South Bethlehem, Pa. App. filed Sept. 26, 1901. A fork is pivoted to the harp and controlled by a weight and the trolley wheel in such a manner as to rise into position when the wheel leaves the wire to return it thereto, after which the fork returns to its normal lowered position.

687,800. PLANT FOR THE ELECTRODEPOSITION OF METAL; A. L. Walker, Perth Amboy, N. J. App. filed March 28, 1900. (See Current News and Notes.)

687,812. CAPPING FOR ELECTRIC CONDUITS; W. F. Bossert, Utica, N. Y. App. filed Dec. 28, 1900. A cylinder having a protecting ring and adapted to be screwed on to the end of the conduit.

687,829. ELECTRIC CONTROLLER; C. H. Keeney, Milwaukee, Wis. App. filed Sept. 14, 1901. In an electric controller system, a single solenoid and its reciprocable core, means actuated by the movement of the solenoid core in one direction for successively cutting out resistance, and mechanical means for putting in the resistance.

687,833. BATTERY; P. E. Francken, Brussels, Belgium. App filed July 25, 1900. Details.

687,861. TROLLEY GUARD; A. W. Smith, Pine River, N. H. App. filed Jan. 16, 1901. The guard is held in normal position by spiral springs surrounding the axle.

687,881. APPARATUS AND CIRCUIT FOR OPERATING ELECTRIC LAMPS; P. C. Hewitt, New York, N. Y. App. filed April 5, 1900. (See page 993.)

687,882. VAPOR LAMP; P. C. Hewitt, New York, N. Y. App. filed April 5, 1900. (See page 993.)

687,883. TERMINAL FOR ELECTRIC VAPOR OR GAS LAMPS; P. C. Hewitt, New York, N. Y. App. filed April 18, 1900. (See page 993.)

687,885. ELECTRIC BATTERY; G. D'Infreville, New York, N. Y. App. filed Jan. 3, 1901. A battery adapted for use either as a primary or secondary and on either an open or closed circuit. It contains a solution of sulphuric acid with an upper electrode of amalgamated zinc, a lower electrode carrying peroxide of lead and with a clear horizontal stratum of the solution between them.

687,893. CARBON APPARATUS AND MACHINERY; W. H. Marshall, Cleveland, Ohio. App. filed April 12, 1901. A method of preserving arc light carbons from impurities in the course of their manufacture, which consists in providing all inner exposed surfaces of the apparatus through which the carbon stock passes with a carbon cover.

687,895. VACUUM BREAKING DEVICE; T. D. Millea, Springfield, Mass. App. filed Jan. 20, 1900. An electro-magnetic valve operating device.

687,903. ELECTRICAL HEAT REGULATING APPARATUS; H. Schultz, Berlin, Germany. App. filed July 29, 1898. A clockwork is used to move a contact of a circuit closer relatively to the expanding medium of a thermometer whereby the temperature at which the circuit closer acts is progressively varied.

687,916. ELECTRIC SWITCH; E. S. Cook and W. H. Chipperhead, London, England. App. filed March 22, 1901. Details.

687,943. ELECTRIC LAMP; T. A. Smith, Azusa, Calif. App. filed Jan. 18, 1900. The globe is formed with an internal tubular pillar around which the filament leads in spiral form the interior of the tube being covered with reflecting material.

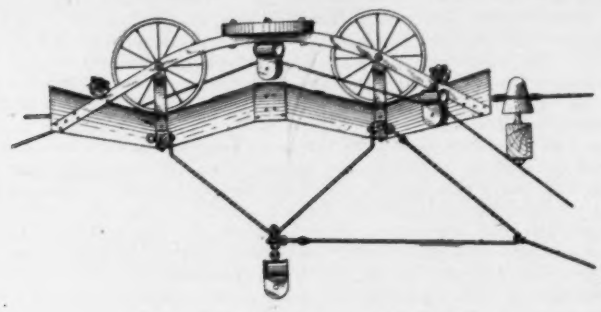
687,948. ELECTRIC SIGNALING AND INDICATING APPARATUS; F. W. Wood, Newport News, Va. App. filed May 13, 1901. The indicator comprises two magnets and an armature carrying the index. The transmitter consists of a rheostat, the terminals of which are respectively connected with the two magnets and its contact arm being so connected as to simultaneously increase the current through one magnet and decrease it through the other.

687,950. TROLLEY; J. Zumbrunnen, Elliott, Pa. App. filed April 4, 1900. Details.

687,982. IMPLEMENT FOR SINKING ELECTRICAL GROUND PLUGS; W. E. Fischer, Bloomsburg, Pa. App. filed April 22, 1901. A grounding plug having a wire attached to it and a driving bar for the plug having a receptacle for the reception of the wire during the driving of the plug, the free end of the wire remaining above the surface of the ground during the driving of the plug.

687,991. DYNAMO FRAME; A. Churchward, Chicago, Ill. App. filed June 12, 1899. Modification of the following.

687,992. DYNAMO ELECTRIC MACHINERY; A. Churchward, Chicago, Ill.



687,727.—Machine for Stringing Wires.

App. filed Dec. 18, 1899. Wrought iron or steel plates are secured to the field frame and wrought iron or steel pole pieces are seated against the plate, the pole pieces being removably secured to the plate.

687,996. TELEPHONE RECEIVER; H. Liebreich, Detroit, Mich. App. filed Nov. 30, 1900. (See page 987.)

687,997. TELEPHONE RECEIVER; H. Liebreich, Detroit, Mich. App. filed Nov. 30, 1900. (See page 987.)

687,998. TELEPHONE RECEIVER; H. Liebreich, Detroit, Mich. App. filed Nov. 30, 1900. (See page 987.)

687,999. TELEPHONE RECEIVER; H. Liebreich, Detroit, Mich. App. filed Nov. 30, 1900. (See page 987.)

688,009. AUTOMATIC MEANS FOR CONSERVING ENERGY OF ELECTRIC BATTERIES; P. Siegel and M. H. Abrahams, New York, N. Y. App. filed April 25, 1901. A clock is arranged to throw the different cells of a battery into circuit successively.

688,025. CONTROLLER FOR ELECTRIC AUTOMOBILES; F. F. Loomis, Akron, Ohio. App. filed May 24, 1900. Details.

688,031. FUSE PLUG FOR CUTOUT BLOCKS; J. Sachs, Hartford, Conn. App. filed Dec. 8, 1900. A fuse case and fuse inclosed therein, a conducting body extending around the fuse-case and appreciably distant therefrom, an engaging electrical connection between the said body and one end of the fuse-case, and an insulating member between the other end of the fuse-case and said conducting body.

688,045. ELECTRIC SIGNALING SYSTEM FOR RAILWAYS; A. J. Wilson, Westfield, N. J. App. filed May 23, 1900. A home signal and a distant signal both located at the entrance of a block; a circuit for the home signal; a circuit for the distant signal; a rail-circuit; means in the rail circuit operated by the home signal for controlling the circuit of the distant signal, whereby the distant signal cannot go to safety unless the home signal is at safety.

688,046. ELECTRIC SIGNALING SYSTEM; A. J. Wilson, Westfield, N. J. App. filed Oct. 23, 1900. Two signals located at a substantial distance from each other; a signal circuit containing two magnets for controlling respectively said signals, one of said magnets being responsive and the other unresponsive to a given current; a resistance coil and means for connecting the resistance coil in multiple with said signal circuit and disconnecting it therefrom for making responsive one or both magnets, whereby one or both signals may be operated.

688,058. INSTRUMENT FOR MEASURING THE RESISTANCE OF ELECTRIC CIRCUITS; E. K. Brown, Springfield, Mass. App. filed April 1, 1901. Details.

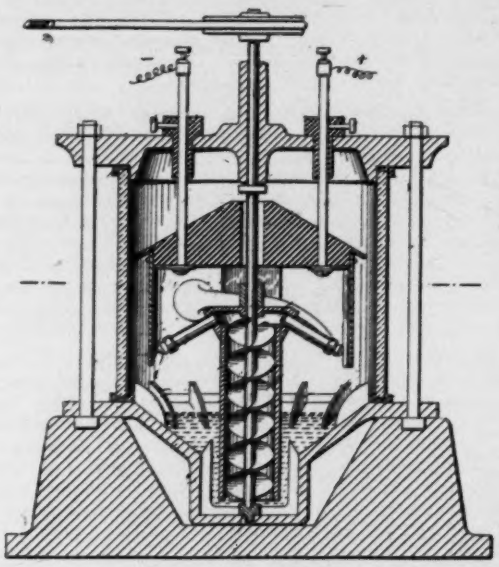
688,068. INTERRUPTER; R. H. Cunningham, New York, N. Y. App. filed July 10, 1901. An interrupter, comprising positive and negative electrodes, and a mercury container having movement relative to the said electrodes and arranged to discharge streams of mercury upon the electrodes to form a periodical conductor between the electrodes.

688,077. POROUS DIAPHRAGM FOR BATTERIES; G. T. Eyanson, Philadelphia, Pa. App. filed May 17, 1901. Glazed porcelain or other earthenware plates are provided with grooves at the edges and across the flat faces, with holes at the points of intersection of vertical and horizontal grooves. A lead frame surrounds the plate and parts of the same extend into the grooves and into the holes at intersections. In making up a complete plate the edges of several plate sections are burned together, thus forming a partition or diaphragm, which diaphragms may be burned together to form a vessel.

688,118. SELECTIVE SYSTEM; S. A. Reed, Middletown, N. J. App. filed Feb. 27, 1901. (See Current News and Notes.)

688,124. TELEPHONE ATTACHMENT; J. A. Rice, Bland, New Mexico. App. filed March 29, 1901. (See page 987.)

688,125. ELECTRIC LAMP SOCKET; J. T. Robb, Flatbush, N. Y. App. filed Sept. 27, 1901. Details.



688,068.—Interrupter.

688,130. CONTROLLER FOR ELECTRIC CARS; B. W. Scott, San Jose, Calif. App. filed April 30, 1901. The lever which moves the brake mechanism at the same time moves a gear segment and rotates a pinion on the shaft of the electric controller.

688,150. ELECTRIC MOTOR; J. Darling, Chicora, Pa. App. filed June 5, 1901. General improvement in construction designed to simplify the motor and to facilitate putting the parts together.

688,170. ELECTRIC FURNACE; J. F. Hammond, New York, N. Y. App. filed Feb. 21, 1901. (See Current News and Notes.)

688,176. REGULATING SOCKET FOR MULTIFILAMENT INCANDESCENT LAMPS; C. A. Hussey, New York, N. Y. App. filed March 16, 1901. Details of a socket for throwing the filaments into circuit singly or together and either in series or parallel.

688,184. AUTOMATIC MONITOR FOR TELEPHONE EXCHANGES; J. B. Lee, Charleston, S. C. App. filed Sept. 1, 1900. (See page 989.)

688,213. THERMOSTATIC FIRE ALARM; H. C. Vierkant, Tarrytown, N. Y. App. filed March 18, 1901. Details.

688,268. PROCESS OF PRODUCING MINE EXPLODERS; N. Schmidt, Kupperstig, Germany. App. filed Dec. 30, 1897. A process for producing mine exploders which consists in forming longitudinal creases in a strip of suitable material, impregnating the same material and feeding conductors into the said creases in such manner as to keep the same insulated from each other, closing the said strip to a cord, drying the same and applying the fuse to the end thereof.

RIC SIGNALING SYSTEM FOR RAILWAYS; A. J. Wil-
, N. J. App. filed May 23, 1900. A home signal and a dis-
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RUPTER; R. H. Cunningham, New York, N. Y. App. filed
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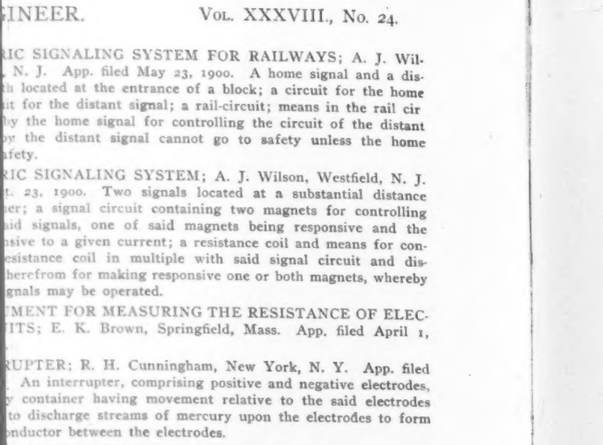
(See Current News and Notes.)

HONE ATTACHMENT; J. A. Rice, Bland, New Mexico.
rch 29, 1901. (See page 987.)

RIC LAMP SOCKET; J. T. Robb, Flatbush, N. Y. App.
1901. Details.



688,068.—Interrupter.

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tate putting the parts together.

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, 1901. (See Current News and Notes.)

LATING SOCKET FOR MULTIFILAMENT INCAN-
LAMPS; C. A. Hussey, New York, N. Y. App. filed March
tails of a socket for throwing the filaments into circuit singly

THE ELECTRICAL WORLD AND ENGINEER'S

MOONLIGHT TABLES FOR 1902

COMPILED BY H. W. FRUND

These schedules are made up on local mean time. Where standard time is used, and it varies considerably from sun time, the proper deduction or addition must be made.

JANUARY, 1902

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.15 P.M.	2	1.45 A.M.
2	5.15 "	3	2.40 "
3	5.15 "	4	3.40 "
4	5.15 "	5	4.35 "
5	5.15 "	6	5.30 "
6	5.15 "	7	6.20 "
7	5.20 "	8	6.20 "
8	5.20 "	9	6.20 "
9	5.20 "	10	6.20 "
40	5.20 "	11	6.20 "
41	5.20 "	12	6.20 "
42	5.20 "	13	6.20 "
43	5.25 "	14	6.20 "
44	5.25 "	15	6.20 "
45	5.25 "	16	6.20 "
46	5.25 "	17	6.20 "
47	5.30 "	17	12.00 M.
48	12.35 A.M.	18	6.20 A.M.
18	5.30 P.M.	18	12.00 M.
19	1.40 A.M.	19	6.20 A.M.
19	5.30 P.M.	19	12.00 M.
20	5.30 "	20	12.00 "
21	5.35 "	21	12.00 "
22	5.35 "	22	12.00 "
23	5.35 "	23	12.00 "
24	5.35 "	24	12.00 "
25	5.35 "	25	12.00 "
26	5.40 "	26	12.00 "
27	5.40 "	27	12.00 "
28	5.40 "	28	12.00 "
29	5.40 "	30	12.30 A.M.
30	5.45 "	31	1.30 "
31	5.45 "	01	2.25 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	5.15 P.M.	2	1.45 A.M.
2	5.15 "	3	2.40 "
3	5.15 "	4	3.40 "
4	5.15 "	5	4.35 "
5	5.15 "	6	5.30 "
6	5.15 "	7	6.20 "
7	5.20 "	8	6.20 "
8	5.20 "	9	6.20 "
9	5.20 "	10	6.20 "
10	5.20 "	11	6.20 "
11	5.20 "	12	6.20 "
12	5.20 "	13	6.20 "
13	5.25 "	14	6.20 "
14	9.15 "	15	6.20 "
15	10.20 "	16	6.20 "
16	11.30 "	17	6.20 "
17	....	..	....
18	12.35 A.M.	18	6.20 "
19	1.40 "	19	6.20 "
20	2.50 "	20	6.20 "
21	3.50 "	21	6.20 "
22	No Light.	22	No Light.
23	"	23	"
24	"	24	"
25	5.35 P.M.	25	8.25 P.M.
26	5.40 "	26	9.30 "
27	5.40 "	27	10.30 "
28	5.40 "	28	11.35 "
29	5.40 "	30	12.30 A.M.
30	5.45 "	31	1.30 "
31	5.45 "	01	2.25 "

FEBRUARY, 1902

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.45 P.M.	2	3.15 A.M.
2	5.50 "	3	4.10 "
3	5.50 "	4	5.00 "
4	5.50 "	5	5.45 "
5	5.50 "	6	6.00 "
6	5.50 "	7	6.00 "
7	5.55 "	8	6.00 "
8	5.55 "	9	6.00 "
9	5.55 "	10	6.00 "
10	5.55 "	11	6.00 "
11	6.00 "	12	6.00 "
12	6.00 "	13	6.00 "
13	6.00 "	14	6.00 "
14	6.00 "	15	6.00 "
15	6.05 "	16	6.00 "
16	6.05 "	16	12.00 M.
17	12.40 A.M.	17	6.00 A.M.
17	6.05 P.M.	17	12.00 M.
18	1.40 A.M.	18	5.50 A.M.
18	6.05 P.M.	18	12.00 M.
19	6.10 "	19	12.00 "
20	6.10 "	20	12.00 "
21	6.10 "	21	12.00 "
22	6.10 "	22	12.00 "
23	6.10 "	23	12.00 "
24	6.15 "	24	12.00 "
25	6.15 "	25	12.00 "
26	6.15 "	26	12.00 "
27	6.15 "	28	12.10 A.M.
28	6.20 P.M.	01	1.05 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	5.45 P.M.	2	3.15 A.M.
2	5.50 "	3	4.10 "
3	5.50 "	4	5.00 "
4	5.50 "	5	5.45 "
5	5.50 "	6	6.00 "
6	5.50 "	7	6.00 "
7	5.55 "	8	6.00 "
8	5.55 "	9	6.00 "
9	5.55 "	10	6.00 "
10	5.55 "	11	6.00 "
11	6.00 "	12	6.00 "
12	6.00 "	13	6.00 "
13	9.20 "	14	6.00 "
14	10.30 "	15	6.00 "
15	11.30 "	16	6.00 "
16	....	..	....
17	12.40 A.M.	17	6.00 "
18	1.40 "	18	5.50 A.M.
19	2.40 "	19	5.50 "
20	3.30 "	20	5.50 "
21	No Light.	21	No Light.
22	"	22	"
23	"	23	"
24	6.15 P.M.	24	9.15 P.M.
25	6.15 "	25	10.15 "
26	6.15 "	26	11.15 "
27	6.15 "	28	12.10 A.M.
28	6.20 P.M.	01	1.05 "

MARCH, 1902

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	6.20 P.M.	2	2.00 A.M.
2	6.20 "	3	2.50 "
3	6.20 "	4	3.35 "
4	6.20 "	5	4.20 "
5	6.25 "	6	5.00 "
6	6.25 "	7	5.25 "
7	6.25 "	8	5.25 "
8	6.25 "	9	5.25 "
9	6.30 "	10	5.20 "
10	6.30 "	11	5.20 "
11	6.30 "	12	5.20 "
12	6.30 "	13	5.15 "
13	6.30 "	14	5.15 "
14	6.35 "	15	5.15 "
15	6.35 "	16	5.10 "
16	6.35 "	17	5.10 "
17	6.35 P.M.	17	12.00 M.
18	1.25 A.M.	18	5.10 A.M.
18	6.35 P.M.	18	12.00 M.
19	2.10 A.M.	19	5.05 A.M.
19	6.40 P.M.	19	12.00 M.
20	6.40 "	20	12.00 "
21	6.40 "	21	12.00 "
22	6.40 "	22	12.00 "
23	6.40 "	23	12.00 "
24	6.45 "	24	12.00 "
25	6.45 "	25	12.00 "
26	6.45 "	26	12.00 "
27	6.45 "	27	12.00 "
28	6.45 "	28	12.00 "
29	6.50 "	30	12.40 A.M.
30	6.50 "	31	1.30 "
31	6.50 "	01	2.10 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	6.20 P.M.	2	2.00 A.M.
2	6.20 "	3	2.50 "
3	6.20 "	4	3.35 "
4	6.20 "	5	4.20 "
5	6.25 "	6	5.00 "
6	6.25 "	7	5.25 "
7	6.25 "	8	5.25 "
8	6.25 "	9	5.25 "
9	6.30 "	10	5.20 "
10	6.30 "	11	5.20 "
11	6.30 "	12	5.20 "
12	6.30 "	13	5.15 "
13	6.30 "	14	5.15 "
14	10.30 "	15	5.15 "
15	11.30 "	16	5.10 "
16	....	..	....
17	12.30 A.M.	17	5.10 "
18	1.25 "	18	5.10 "
19	2.10 "	19	5.05 "
20	2.50 "	20	5.05 "
21	3.25 "	21	5.00 "
22	No Light.	22	No Light.
23	"	23	"
24	"	24	"
25	6.45 P.M.	25	9.00 P.M.
26	6.45 "	26	10.00 "
27	6.45 "	27	11.00 "
28	6.45 "	28	11.50 "
29	6.50 "	30	12.40 A.M.
30	6.50 "	31	1.30 "
31	6.50 "	01	2.10 "

APRIL, 1902

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	6.50 P.M.	2	2.50 A.M.
2	6.50 "	3	3.30 "
3	6.55 "	4	4.05 "
4	6.55 "	5	4.40 "
5	6.55 "	6	4.35 "
6	6.55 "	7	4.35 "
7	6.55 "	8	4.35 "
8	7.00 "	9	4.30 "
9	7.00 "	10	4.30 "
10	7.00 "	11	4.30 "
11	7.00 "	12	4.30 "
12	7.00 "	13	4.30 "
13	7.05 "	14	4.25 "
14	7.05 "	15	4.25 "
15	7.05 "	15	12.00 M.
16	12.50 A.M.	16	4.25 A.M.
16	7.05 P.M.	16	12.00 M.
17	1.25 A.M.	17	4.20 A.M.
17	7.05 P.M.	17	12.00 M.
18	2.00 A.M.	18	4.20 A.M.
18	7.10 P.M.	18	12.00 M.
19	2.30 A.M.	19	4.20 "
19	7.10 P.M.	19	12.00 M.
20	3.00 A.M.	20	4.15 "
20	7.15 P.M.	20	12.00 M.

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	6.50 P.M.	2	2.50 A.M.
2	6.50 "	3	3.30 "
3	6.55 "	4	4.05 "
4	6.55 "	5	4.40 "
5	6.55 "	6	4.35 "
6	6.55 "	7	4.35 "
7	6.55 "	8	4.35 "
8	7.00 "	9	4.30 "
9	7.00 "	10	4.30 "
10	7.00 "	11	4.30 "
11	7.00 "	12	4.30 "
12	10.30 "	13	4.30 "
13	11.20 "	14	4.25 "
14	....	..	....
15	12.10 A.M.	15	4.25 "
16	12.50 "	16	4.25 "
17	1.25 "	17	4.20 "
18	2.00 "	18	4.20 "
19	2.30 "	19	4.20 "
20	3.00 "	20	4.15 "

MAY, 1902

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.20 P.M.	2	2.40 A.M.
2	7.20 "	3	3.10 "
3	7.25 "	4	3.45 "
4	7.25 "	5	3.55 "
5	7.25 "	6	3.55 "
6	7.25 "	7	3.50 "
7	7.25 "	8	3.50 "
8	7.30 "	9	3.50 "
9	7.30 "	10	3.50 "
10	7.30 "	11	3.50 "
11	7.30 "	12	3.45 "
12	7.30 "	13	3.45 "
13	7.35 "	14	3.45 "
14	7.35 "	15	3.40 "
15	7.35 "	16	3.40 "
16	7.35 "	16	12.00 M.
17	1.00 A.M.	17	3.40 A.M.
17	7.35 P.M.	17	12.00 M.
18	1.35 A.M.	18	3.40 A.M.
18	7.40 P.M.	18	12.00 M.
19	2.00 A.M.	19	3.40 A.M.
19	7.40 P.M.	19	12.00 M.
20	2.30 A.M.	20	3.40 A.M.
20	7.45 P.M.	20	12.00 M.

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	7.20 P.M.	2	2.40 A.M.
2	7.20 "	3	3.10 "
3	7.25 "	4	3.45 "
4	7.25 "	5	3.55 "
5	7.25 "	6	3.55 "
6	7.25 "	7	3.50 "
7	7.25 "	8	3.50 "
8	7.30 "	9	3.50 "
9	7.30 "	10	3.50 "
10	7.30 "	11	3.50 "
11	10.00 "	12	3.45 "
12	10.50 "	13	3.45 "
13	11.25 "	14	3.45 "
14	12.00 M.	15	3.40 "
15	....	..	....
16	12.35 A.M.	16	3.40 "
17	1.00 "	17	3.40 "
18	1.35 "	18	3.40 "
19	2.00 "	19	3.40 "
20	No Light.	20	No Light.
21	"	21	"

JUNE, 1902

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.50 P.M.	2	2.50 A.M.
2	7.50 "	3	3.30 "
3	7.50 "	4	3.30 "
4	7.50 "	5	3.30 "
5	7.50 "	6	3.30 "
6	7.55 "	7	3.30 "
7	7.55 "	8	3.30 "
8	7.55 "	9	3.30 "
9	7.55 "	10	3.30 "
10	7.55 "	11	3.30 "
11	7.55 "	12	3.30 "
12	7.55 "	13	3.30 "
13	7.55 "	14	3.30 "
14	7.55 "	15	3.30 "
15	7.55 "	15	12.00 M.
16	12.40 A.M.	16	3.30 A.M.
16	7.55 P.M.	16	12.00 M.
17	8.00 "	17	12.00 "
18	8.00 "	18	12.00 "
19	8.00 "	19	12.00 "
20	8.00 "	20	12.00 "
21	"	21	"

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	7.50 P.M.	2	2.50 A.M.
2	7.50 "	3	3.30 "
3	7.50 "	4	3.30 "
4	7.50 "	5	3.30 "
5	7.50 "	6	3.30 "
6	7.55 "	7	3.30 "
7	7.55 "	8	3.30 "
8	7.55 "	9	3.30 "
9	7.55 "	10	3.30 "
10	7.55 "	11	3.30 "
11	9.30 "	12	3.30 "
12	11.10 "	13	3.30 "
13	11.40 "	14	3.30 "
14	....	..	....
15	12.10 A.M.	15	3.30 "
16	12.40 "	16	3.30 "
17	1.15 "	17	3.30 "
18	1.50 "	18	3.30 "
19	No Light.	19	No Light.
20	"	20	"
21	"	21	"

LATING SOCKET FOR MULTIFILAMENT INCAN-LAMPS; C. A. Hussey, New York, N. Y. App. filed March Details of a socket for throwing the filaments into circuit singly nd either in series or parallel.

MATIC MONITOR FOR TELEPHONE EXCHANGES; J. B. ston, S. C. App. filed Sept. 1, 1900. (See page 989.)

MOSTATIC FIRE ALARM; H. C. Vierkant, Tarrytown, N. ed March 18, 1901. Details.

ESS OF PRODUCING MINE EXPLODERS; N. Schmidt, Germany. App. filed Dec. 30, 1897. A process for producing ers which consists in forming longitudinal creases in a strip of terial, impregnating the same material and feeding conductors d creases in such manner as to keep the same insulated from closing the said strip to a cord, drying the same and applying the end thereof.

JULY, 1902

Table No. 1. Frund's Moonlight System.

Date.	Exting.	Date.	Light.
1	8.00 P.M.	2	2.50 A.M.
2	8.00 "	3	3.35 "
3	8.00 "	4	3.35 "
4	8.00 "	5	3.35 "
5	8.00 "	6	3.35 "
6	8.00 "	7	3.35 "
7	8.00 "	8	3.35 "
8	8.00 "	9	3.35 "
9	8.00 "	10	3.35 "
10	8.00 "	11	3.35 "
11	8.00 "	12	3.40 "
12	8.00 "	13	3.40 "
13	8.00 "	14	3.40 "
14	8.00 "	15	3.40 "
15	8.00 "	16	3.40 "
16	8.00 "	17	12.00 M.
17	8.00 "	17	12.00 "
18	8.00 "	18	12.00 "
19	8.00 "	19	12.00 "
20	7.55 "	20	12.00 "
21	7.55 "	21	12.00 "
22	7.55 "	22	12.00 "
23	7.55 "	23	12.00 "
24	7.55 "	24	12.00 "
25	7.55 "	25	12.00 "
26	7.50 "	26	12.00 "
27	7.50 "	27	12.00 "
28	7.50 "	29	12.45 A.M.
29	7.50 "	30	1.30 "
30	7.50 "	31	2.25 "
31	7.50 "	01	3.30 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	8.00 P.M.	2	2.50 A.M.
2	8.00 "	3	3.35 "
3	8.00 "	4	3.35 "
4	8.00 "	5	3.35 "
5	8.00 "	6	3.35 "
6	8.00 "	7	3.35 "
7	8.00 "	8	3.35 "
8	8.00 "	9	3.35 "
9	8.00 "	10	3.35 "
10	9.40 "	11	3.35 "
11	10.10 "	12	3.40 "
12	10.40 "	13	3.40 "
13	11.15 "	14	3.40 "
14	11.50 "	15	3.40 "
15	...	..	...
16	12.30 A.M.	16	3.40 "
17	1.15 "	17	3.45 "
18	2.00 "	18	3.45 "
19	No Light.	19	No Light.
20	"	20	"
21	"	21	"
22	7.55 P.M.	22	9.15 P.M.
23	7.55 "	23	9.50 "
24	7.55 "	24	10.20 "
25	7.55 "	25	10.50 "
26	7.50 "	26	11.25 "
27	7.50 "	27	12.00 M.
28	7.50 "	29	12.45 A.M.
29	7.50 "	30	1.30 "
30	7.50 "	31	2.25 "
31	7.50 "	01	3.30 "

AUGUST, 1902

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.45 P.M.	2	4.00 A.M.
2	7.45 "	3	4.00 "
3	7.45 "	4	4.00 "
4	7.40 "	5	4.00 "
5	7.40 "	6	4.00 "
6	7.40 "	7	4.00 "
7	7.40 "	8	4.00 "
8	7.40 "	9	4.05 "
9	7.35 "	10	4.05 "
10	7.35 "	11	4.05 "
11	7.35 "	12	4.05 "
12	7.35 "	13	4.05 "
13	7.30 "	14	4.10 "
14	7.30 "	14	12.00 M.
15	13.50 A.M.	15	4.10 A.M.
15	7.30 P.M.	15	12.00 M.
16	1.40 A.M.	16	4.10 A.M.
16	7.30 P.M.	16	12.00 M.
17	7.25 "	17	12.00 "
18	7.25 "	18	12.00 "
19	7.25 "	19	12.00 "
20	7.25 "	20	12.00 "
21	7.20 "	21	12.00 "
22	7.20 "	22	12.00 "
23	7.20 "	23	12.00 "
24	7.20 "	24	12.00 "
25	7.15 "	25	12.00 "
26	7.15 "	27	12.20 A.M.
27	7.15 "	28	1.20 "
28	7.10 "	29	2.20 "
29	7.10 "	30	3.30 "
30	7.10 "	31	4.25 "
31	7.05 "	01	4.25 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	7.45 P.M.	2	4.00 A.M.
2	7.45 "	3	4.00 "
3	7.45 "	4	4.00 "
4	7.45 "	5	4.00 "
5	7.40 "	6	4.00 "
6	7.40 "	7	4.00 "
7	7.40 "	8	4.00 "
8	8.40 "	9	4.05 "
9	9.15 "	10	4.05 "
10	9.55 "	11	4.05 "
11	10.30 "	12	4.05 "
12	11.15 "	13	4.05 "
13	12.00 M.	14	4.10 "
14	...	..	...
15	12.50 A.M.	15	4.10 "
16	1.40 "	16	4.10 "
17	2.40 "	17	4.10 "
18	No Light.	18	No Light.
19	"	19	"
20	"	20	"
21	7.20 P.M.	21	8.55 P.M.
22	7.20 "	22	9.30 "
23	7.20 "	23	10.05 "
24	7.20 P.M.	24	10.45 "
25	7.15 "	25	11.30 "
26	7.15 "	27	12.20 A.M.
27	7.15 "	28	1.20 "
28	7.10 "	29	2.20 "
29	7.10 "	30	3.30 "
30	7.10 "	31	4.25 "
31	7.05 "	01	4.25 "

SEPTEMBER, 1902

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	7.05 P.M.	2	4.25 "
2	7.05 "	3	4.25 "
3	7.00 "	4	4.25 "
4	7.00 "	5	4.30 "
5	7.00 "	6	4.30 "
6	6.55 "	7	4.30 "
7	6.55 "	8	4.30 "
8	6.55 "	9	4.30 "
9	6.50 "	10	4.30 "
10	6.50 "	11	4.30 "
11	6.50 "	12	4.35 "
12	6.50 "	13	4.35 "
13	6.45 "	13	12.00 M.
14	6.45 "	14	12.00 "
15	6.45 "	15	12.00 "
16	6.40 "	16	12.00 "
17	6.40 "	17	12.00 "
18	6.40 "	18	12.00 "
19	6.35 "	19	12.00 "
20	6.35 "	20	12.00 "
21	6.35 "	21	12.00 "
22	6.30 "	22	12.00 "
23	6.30 "	23	12.00 "
24	6.30 "	25	12.15 A.M.
25	6.25 "	26	1.15 "
26	6.25 "	27	2.25 "
27	6.25 "	28	3.30 "
28	6.20 "	29	4.40 "
29	6.20 "	30	4.55 "
30	6.20 "	01	4.55 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	7.05 P.M.	2	4.25 A.M.
2	7.05 "	3	4.25 "
3	7.00 "	4	4.25 "
4	7.00 "	5	4.30 "
5	7.00 "	6	4.30 "
6	6.55 "	7	4.30 "
7	8.25 "	8	4.30 "
8	9.10 "	9	4.30 "
9	9.50 "	10	4.30 "
10	10.40 "	11	4.30 "
11	11.35 "	12	4.35 "
12	...	..	...
13	12.30 A.M.	13	4.35 "
14	1.25 "	14	4.35 "
15	2.25 "	15	4.40 "
16	No Light.	16	No Light.
17	"	17	"
18	"	18	"
19	6.35 P.M.	19	8.10 P.M.
20	6.35 "	20	8.45 "
21	6.35 "	21	9.30 "
22	6.30 "	22	10.20 "
23	6.30 "	23	11.15 "
24	6.30 "	25	12.15 A.M.
25	6.25 "	26	1.15 "
26	6.25 "	27	2.25 "
27	6.25 "	28	3.30 "
28	6.20 "	29	4.40 "
29	6.20 "	30	4.55 "
30	6.20 "	01	4.55 "

OCTOBER, 1902

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	6.15 P.M.	2	4.55 A.M.
2	6.15 "	3	4.55 "
3	6.15 "	4	4.55 "
4	6.10 "	5	5.00 "
5	6.10 "	6	5.00 "
6	6.10 "	7	5.00 "
7	6.05 "	8	5.00 "
8	6.05 "	9	5.00 "
9	6.05 "	10	5.00 "
10	6.00 "	11	5.05 "
11	6.00 "	12	5.05 "
12	6.00 "	13	5.05 "
13	5.55 "	13	12.00 M.
14	5.55 "	14	12.00 M.
15	5.55 "	15	12.00 "
16	5.55 "	16	12.00 "
17	5.50 "	17	12.00 "
18	5.50 "	18	12.00 "
19	5.50 "	19	12.00 "
20	5.45 "	20	12.00 "
21	5.45 "	21	12.00 "
22	5.45 "	22	12.00 "
23	5.45 "	24	12.15 A.M.
24	5.40 "	25	1.20 "
25	5.40 "	26	2.30 "
26	5.40 "	27	3.30 "
27	5.35 "	28	4.35 "
28	5.35 "	29	5.25 "
29	5.35 "	30	5.25 "
30	5.35 "	31	5.25 "
31	5.30 "	01	5.25 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	6.15 P.M.	2	4.55 A.M.
2	6.15 "	3	4.55 "
3	6.15 "	4	4.55 "
4	6.10 "	5	5.00 "
5	6.10 "	6	5.00 "
6	6.10 "	7	5.00 "
7	8.35 "	8	5.00 "
8	9.25 "	9	5.00 "
9	10.15 "	10	5.00 "
10	11.10 "	11	5.05 "
11	...	..	...
12	12.10 A.M.	12	5.05 "
13	1.10 "	13	5.05 "
14	2.10 "	14	5.05 "
15	3.15 "	15	5.10 "
16	No Light.	16	No Light.
17	"	17	"
18	"	18	"
19	5.50 P.M.	19	8.10 P.M.
20	5.45 "	20	9.10 "
21	5.45 "	21	10.10 "
22	5.45 "	22	11.10 "
23	5.45 "	24	12.15 A.M.
24	5.40 "	25	1.20 "
25	5.40 "	26	2.30 "
26	5.40 "	27	3.30 "
27	5.35 "	28	4.35 "
28	5.35 "	29	5.25 "
29	5.35 "	30	5.25 "
30	5.35 "	31	5.25 "
31	5.30 "	01	5.25 "

NOVEMBER, 1902

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.30 P.M.	2	5.30 A.M.
2	5.30 "	3	5.30 "
3	5.30 "	4	5.30 "
4	5.30 "	5	5.30 "
5	5.25 "	6	5.35 "
6	5.25 "	7	5.35 "
7	5.25 "	8	5.35 "
8	5.25 "	9	5.35 "
9	5.20 "	10	5.35 "
10	5.20 "	10	12.00 M.
11	1.00 A.M.	11	5.40 A.M.
11	5.20 P.M.	11	12.00 M.
12	5.20 "	12	12.00 "
13	5.20 "	13	12.00 "
14	5.20 "	14	12.00 "
15	5.15 "	15	12.00 "
16	5.15 "	16	12.00 "
17	5.15 "	17	12.00 "
18	5.15 "	18	12.00 "
19	5.15 "	19	12.00 "
20	5.15 "	20	12.00 "
21	5.10 "	22	12.20 A.M.
22	5.10 "	23	1.25 "
23	5.10 "	24	2.30 "
24	5.10 "	25	3.30 "
25	5.10 "	26	4.30 "
26	5.10 "	27	5.30 "
27	5.10 "	28	6.00 "
28	5.10 "	29	6.00 "
29	5.10 "	30	6.00 "
30	5.10 "	01	6.00 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	5.30 P.M.	2	5.30 A.M.
2	5.30 "	3	5.30 "
3	5.30 "	4	5.30 "
4	5.30 "	5	5.30 "
5	8.10 "	6	5.35 "
6	9.00 "	7	5.35 "
7	10.00 "	8	5.35 "
8	11.00 "	9	5.35 "
9	12.09 M.	10	5.35 "
10	...	..	...
11	1.00 A.M.	11	5.40 "
12	2.00 "	12	5.40 "
13	3.10 "	13	5.40 "
14	4.10 "	14	5.45 "
15	No Light.	15	No Light.
16	"	16	"
17	5.15 P.M.	17	7.55 P.M.
18	5.15 "	18	9.00 "
19	5.15 "	19	10.10 "
20	5.15 "	20	11.15 "
21	5.10 "	22	12.20 A.M.
22	5.10 "	23	1.25 "
23	5.10 "	24	2.30 "
24	5.10 "	25	3.30 "
25	5.10 "	26	4.30 "
26	5.10 "	27	5.30 "
27	5.10 "	28	6.00 "
28	5.10 "	29	6.00 "
29	5.10 "	30	6.00 "
30	5.10 "	01	6.00 "

DECEMBER, 1902

Table No. 1. Frund's Moonlight System.

Date.	Light.	Date.	Exting.
1	5.05 P.M.	2	6.00 A.M.
2	5.05 "	3	6.00 "
3	5.05 "	4	6.05 "
4	5.05 "	5	6.05 "
5	5.05 "	6	6.05 "
6	5.05 "	7	6.05 "
7	5.05 "	8	6.10 "
8	5.05 "	9	6.10 "
9	5.05 "	10	6.10 "
10	5.05 "	10	12.00 M.
11	5.05 "	11	12.00 "
12	5.05 "	12	12.00 "
13	5.05 "	13	12.00 "
14	5.05 "	14	12.00 "
15	5.05 "	15	12.00 "
16	5.05 "	16	12.00 "
17	5.05 "	17	12.00 "
18	5.05 "	18	12.00 "
19	5.05 "	19	12.00 "
20	5.05 "	21	12.20 A.M.
21	5.05 "	22	1.25 "
22	5.05 "	23	2.25 "
23	5.05 "	24	3.35 "
24	5.05 "	25	4.20 "
25	5.05 "	26	5.20 "
26	5.10 "	27	6.10 "
27	5.10 "	28	6.20 "
28	5.10 "	29	6.20 "
29	5.10 "	30	6.20 "
30	5.10 "	31	6.20 "
31	5.10 "	01	6.20 "

Table No. 2. Standard Moonlight System.

Date.	Light.	Date.	Exting.
1	5.05 P.M.	2	6.00 A.M.
2	5.05 "	3	6.00 "
3	5.05 "	4	6.05 "
4	7.50 "	5	6.05 "
5	8.45 "	6	6.05 "
6	9.45 "	7	6.05 "
7	10.40 "	8	6.10 "
8	11.40 "	9	6.10 "
9	...	..	...
10	12.45 A.M.	10	6.10 "
11	1.50 "	11	6.10 "
12	3.00 "	12	6.10 "
13	4.10 "	13	6.15 "
14	No Light.	14	No Light.
15	"	15	"
16	5.05 P.M.	16	7.45 P.M.
17	5.05 "	17	9.00 "
18	5.05 "	18	10.10 "
19	5.05 "	19	11.15 "
20	5.05 "	21	12.20 A.M.
21	5.05 "	22	1.25 "
22	5.05 "	23	2.25 "
23	5.05 "	24	3.25 "
24	5.05 "	25	4.20 "
25	5.05 "	26	5.20 "
26	5.10 "	27	6.10 "
27	5.10 "	28	6.20 "
28	5.10 "	29	6.20 "
29	5.10 "	30	6.20 "
30	5.10 "	31	6.20 "
31	5.10 "	01	6.20 "